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MAP TYPES AND RELATED WEATHER OVER THE
MACKENZIE VALLEY

by



PETER ROSS SCHOLEFIELD

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "Map Types and Related Weather Over the Mackenzie Valley", submitted by Peter Ross Scholefield in partial fulfilment of the requirements for the degree of Master of Science in Meteorology.

DEDICATION

*This thesis is dedicated to
my loving wife, Heather
son, Scott
and
daughter, Melina*

ABSTRACT

Knowledge of the relationship between synoptic surface weather-map patterns and various weather parameters is fundamental to the production of an aviation forecast. A sound training in atmospheric dynamics, combined with actual forecast experience, enables a forecaster to obtain an understanding of this complex relationship. Statistical information, based on historical data, would be a useful aid to the aviation forecaster in that it would objectively expand his knowledge gained through experience. This thesis examines the relationships between objectively determined surface map types and associated weather. Percent probabilities of occurrence of aviation weather parameters associated with the map types are calculated, and those for ceiling and visibility categories are used as a simple conditional-probability forecast model. The map-type forecasts are tested against pure climatological forecasts using an independent data sample.

A catalogue of surface map types occurring over the Mackenzie River Valley during the three coldest winter months is developed from 27 years (1946-1972) of MSL grid-point pressure data. The computerized correlation methods developed by the United States Air Force (USAF) at Colorado Springs were used to produce the catalogue. The catalogue comprises a summary of the occurrence and pressure characteristics of map types in addition to a chronological listing of the types assigned to each of the 3814 maps in the data

base. Interesting relationships between map types in the catalogue and climatic anomalies at Yellowknife are presented.

Twenty years (1953-1972) of hourly weather data for Yellowknife are used to examine the relationships between map types and aviation weather parameters. Percent probabilities of occurrence of ceiling and visibility categories, precipitation, wind speed and wind direction, associated with map types, are calculated from the first 16 years of hourly data. The conditional probabilities of ceilings and visibilities are used to forecast these same parameter occurrences during the four years 1969-1972. Map-type forecasts were generally better than pure climatological forecasts over this period. Poor forecast reliability, caused by over-stratification of the data, emerged as a major problem when the map types were stratified by pressure gradient. Methods to improve reliability and some suggestions are presented.

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I wish to thank my employer of the Atmospheric Environment Service for granting me a leave of absence and generously providing financial support during my three years of graduate study.

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CHAPTER I

INTRODUCTION

1.1 Statistical Weather Prediction by Correlation Methods

With continued advances of computer technology into the field of meteorology there has been increasing interest in the development of statistical weather prediction techniques. Two of the more common approaches to the development of probabilistic forecast aids are through the development of regression equations and through the association of weather with map patterns. A desirable feature of the map pattern approach is that it conforms to the traditional forecasting practice of relating weather parameters to synoptic map patterns. Until recently this approach has been hampered by the subjectivity required in the identification of similar map patterns or types.

The objective correlation technique, developed by Lund (1963) and later modified by the USAF, has been used in several studies to classify and identify weather map types. It entails calculating the simple linear correlation coefficient between the values of a specific meteorological quantity on a weather map and those values at the same location on other weather maps. Maps that are highly correlated with each other are grouped into designated types. Those maps that

do not correlate highly with any of the maps are assigned to an uncorrelated group. This group may also contain some maps that correlate highly with only a few maps which, when taken as a group, are not numerous enough to constitute a type.

Once the maps have been grouped into types, climatic data from within the map-type region are used to study the relationships between weather phenomena and the map types. Most of these correlation studies have involved the relationship between precipitation and map types (Augulus, 1969 and 1970; Hartranft et al., 1970b; Paegle and Kierluf, 1974; Kociuba, 1974; Paegle and Wright, 1975).

1.2 USAF Applications of Map-Type Climatology to the Prediction of Visibilities and Ceilings

The incorporation of objective map-type classification and identification techniques into the statistical prediction of ceilings and visibilities was proposed in the United States Air Force (USAF) publication on map typing by Hartranft et al. (1970a) in Colorado Springs. They suggested the development of seasonal, surface map-type catalogues for six designated areas or "windows" across the continental United States (CONUS). It was believed that stratifying conditional climatology tables (CC) according to the catalogued map types would improve this type of objective forecast aid by incorporating the causative synoptic situation into these purely climatological tables.

CC tables give the climatological probabilities of the ceiling and visibility categories occurring at selected time

intervals after an initial time when the initial categories are given. The standard tables are usually stratified by season and time of day. Restivo (1966) elaborates on the development of these tables which are also referred to as persistence probability tables. CC tables were produced for several of the winter map types in the Great Lakes window using November hourly weather data from Duluth, Minnesota. Results based on the dependent data sample showed that map-type-stratified, conditional climatology (MTCC) tables offered a significant improvement over the standard CC tables.

After two years of continued research of map-typing concepts, refinement and documentation of development techniques at Colorado Springs (Sabin, 1972; Sabin and Nieman, 1972; Scholefield, 1972 and 1973a; Wold, 1973; Sabin, 1974) a map-type forecast system was officially proclaimed by the USAF Air Weather Service in June of 1972 (Scholefield, 1973b). A Map-Typing Project Office was established at Colorado Springs which produced map-type catalogues for fourteen CONUS windows, two in Europe and one for Japan. MTCC tables were produced from these catalogues for several USAF forecast offices. It had been planned to incorporate MTCC into the USAF Global Weather Center's automated terminal forecast model as a climatological check in the forecast procedure. CC tables stratified by wind direction (WSCC) were currently being used for this purpose.

1.3 Verification Results

In 1974, at Colorado Springs, a verification procedure was carried out using two years of independent data to compare the

performance of CC, MTCC and WSCC models in the forecasting of ceiling and visibility categories. Tables were developed from thirteen to sixteen years of dependent data. Contingency tables were constructed for the three forecast models and for a persistence model. Skill scores were calculated for each model against chance and persistence. The overall results showed little difference between the four models. The results of this verification have not yet been published, but they indicate that stratification of the standard CC tables by map types or wind direction do not significantly improve the forecasting ability of the standard tables. This conclusion is contrary to what had been previously indicated by tests involving only dependent data.

Air Weather Service is currently concentrating its statistical prediction efforts on the model output statistics (MOS) approach to the objective forecasting of ceilings and visibilities (Bocchiere et al., 1972 and 1974). Results of the rigorous verification of the MOS models for forecasting ceilings and visibilities have been encouraging. Forecasts from MOS models have been shown to be an improvement over climatology and persistence forecasts. They even verified better than official subjective forecasts beyond the short range period. There are some disadvantages to the MOS approach, including the short period of data available for model development and the fact that the models become obsolete with the introduction of new or improved numerical weather prediction models.

One advantage that the map-type approach has over regression models such as MOS is that the verification results can be stratified by the relevant synoptic weather situation. The map-type forecast can then be shown to give relatively better or worse results under

different synoptic situations. The Colorado Springs verification did not consider this aspect nor was there any attempt made to improve the verification results by further stratification of ceiling and visibility data. Further research and a more detailed verification is required to assess the usefulness of map-type climatology in the development of automated forecast aids.

The Map-Typing Project Office in Colorado Springs is currently in the process of dissolution because of the disappointing verification results and the current USAF involvement with MOS techniques. The possibility exists that the map-type catalogues will not be used for their intended purpose of providing a regional synoptic history of surface pressure patterns which, when related to aviation weather parameters, could be a useful aid to the aviation forecaster.

1.4 Purpose

It is the intent of this thesis to apply the basic map-type techniques developed in Colorado Springs to the development of a surface map-type catalogue for the Mackenzie River Valley for the three coldest winter months. Included in the catalogue are statistics on the frequency of occurrence of map types, sequences of types and a listing of the map types occurring on each day of the 27-year period.

Yellowknife hourly weather observations at map time and at three hours before and after map time are examined to show the relationship between significant weather parameters and the map types near the time of their occurrence. Percent probabilities of occurrence

of the parameters are determined for sixteen years of dependent data. These probabilities are used to predict the occurrence of ceiling and visibility categories and the results are verified using four years of independent data.

Hourly observations at three-hour intervals from six hours before a map-type occurrence to twenty-four hours after its occurrence are used in the verification procedure. In addition to comparing verification results at different hours, a comparison is made between verification results for 00Z, 12Z and combined 00Z and 12Z maps. The final step in the verification procedure is an analysis of the results of forecasts based on map types that have been stratified according to pressure gradients. The purpose of these comparisons is to determine the best way to proceed in the development of an automated objective forecast aid. The improvement of map-type forecasts over pure climatological forecasts is carefully documented in order to assess the usefulness of this objective forecast technique.

CHAPTER II

THE BASIC DATA

2.1 Geographical Area

The difficulty in accurately forecasting weather for aviation terminals in the Mackenzie River Valley was appreciated during a forecasting assignment at the Arctic Weather Centre (AWC) in the summer of 1974. The sparseness of observational data and the formidable mountain ranges west of the valley are factors which challenge a forecaster's ability. A well-tested and readily accessible climatological synoptic forecast aid could be of considerable benefit to the forecasters at the AWC.

The area or window used in the map-typing procedure is shown on Figure 2 which is located in Appendix 1. The window includes the 20 grid points which are numbered in the figure. Its size conforms with the criteria used by the Map-Typing Project Office to delineate the fourteen CONUS windows (Nieman and Sabin, 1972). It is large enough to enclose typical synoptic systems but not so large that small synoptic features might be ignored in the correlation of the overall pressure pattern. Printed on Figure 2 are the location

identifiers of those terminals for which 12-hour Terminal forecasts (FT's) are routinely prepared by the Atmospheric Environment Service (AES). Yellowknife (YZF) has the most extensive and complete set of hourly weather records in the Northwest Territories and for this reason was chosen as the principal site to be used in this study.

2.2 Surface Data

A 26-year data base (1946-1971) of mean sea level (MSL) pressures located at grid points on a standard 381 km grid was acquired from the Map-Typing Project Office in Colorado Springs. The data, arranged by month, are stored on two magnetic tapes. Pressures are available for 306 grid points on an 18 x 17 grid network which encompasses all of Canada, including the Arctic Islands and the Beaufort Sea. December, January and February pressure values at the twenty Mackenzie-window grid points were extracted from the two master tapes and stored on one smaller tape. MSL 12Z pressures are available for every year and 00Z values are available for the years 1956-1960 and 1963-1971. There is an exception in the case of December which has 00Z pressure values for the years 1955-1959 and 1962-1971. Consideration was given to incorporating upper-level patterns into the scheme by developing a catalogue of 500-1000 mb thickness patterns. Unfortunately, a comparable set of 500 mb height data was not readily available.

Twenty years (1953-1972) of continuous hourly weather observations for Yellowknife were obtained from the AES. The data are chronologically ordered and stored on magnetic tape in the

standard AES card 1 type format. Data for November 30, all of December, January, February and March 1 were extracted from this tape and stored on a separate tape.

To maximize the use of the twenty years of observations, 1972 grid-point pressure values for the three coldest months were extracted by hand from 00Z and 12Z surface analyses stored at the AWC. These maps were also used to acquire pressure data for missing and incorrect data in the 26-year data base. A date check of the pressure data base had uncovered several errors and duplications which had to be corrected.

2.3 Aviation Weather Parameters

The selection of ceiling and visibility categories was based on a discussion with the Officer-in-Charge of the AWC, and on the classification that is used in hourly data summaries (Climatology Division, 1958). The categories are defined in Table 1.

Table 1
Significant categories of ceilings and visibilities

Category	Ceiling (feet)	Visibility (miles)
A	0 - 400	0 - 3/4
B	500 - 900	1 - 2 1/2
C	1000 - 4500	3 - 5
D	≥ 5000	≥ 6

Categories A and B are below, and C and D are above the standard Visual Flight Rules (VFR) limits of 1000-foot ceiling and three-mile visibility. The 5000-foot ceiling and six-mile visibility limits are used in the international TAFOR code to delineate conditions significant to aviation. The occurrence of any amount of precipitation in excess of a "trace" is considered significant. Ice crystals, blowing and drifting snow are not considered as precipitation in this context. Expected windspeeds less than or equal to 12 miles per hour need not be forecast on an FT, but winds greater than 12 miles per hour are considered significant.

Wind direction is not usually a critical aviation forecast parameter and is not as difficult to forecast as are the other parameters already mentioned. Wind direction is, however, very dependent on the pressure configuration. It was therefore decided to use five simple direction categories to verify the anticipated good relationship between wind direction and the map types. The categories are defined as follows:

N - north northwest to northeast

E - east northeast to southeast

S - south southeast to southwest

W - west southwest to northwest

0 - calm

It has been previously mentioned that the hourly data were stratified according to pressure gradient. Increased stratification is desirable in order to define more accurately the conditions associated with the significant weather parameters. Too much strat-

ification will reduce the number of cases available for calculating the probabilities of occurrence to such an extent that the resulting statistics would not be reliable. Having only four categories of ceiling and visibility, instead of five or six, will help alleviate this problem. The available data are further maximized by considering a three-month cold season instead of individual months.

2.4 The Cold Season

Winter is the longest season of the year in the Mackenzie Valley and the winter months have greater percentages of poor aviation weather than summer months. Ten years (1957-1966) of Yellowknife hourly data summaries (Climatology Division, 1968) of temperature, precipitation, visibility and ceiling categories were examined. It was determined that a relatively uniform cold season exists for the three months of December, January and February.

Figure 1 shows the monthly frequency of occurrence of weather below VFR conditions. The predominance of "bad" weather during the winter is the principal reason why a three-month cold season is used in the study. The reduced number of bad-weather cases during the warmer months could create statistical reliability problems for highly stratified data.

The figure does show significant differences in the monthly frequencies of bad weather in the winter. The frequencies are greater than 20 percent in the earlier part of the winter and drop to less than six percent in late winter. Much of this bad weather in October and November is probably due to the influence of Great Slave Lake

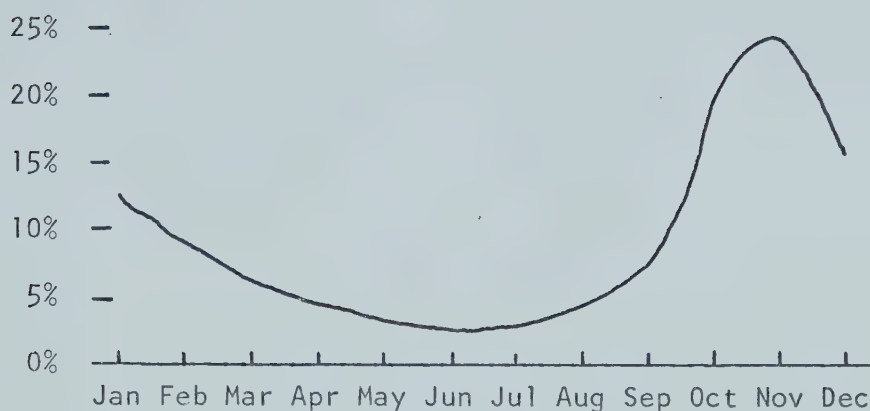


Figure 1. Average percent frequency of weather below VFR (ceiling 0-900 feet and/or visibility 0-2½ miles) based on ten years (1957-1966) of hourly observations at Yellowknife.

which does not freeze over until December (Allen and Cudbird, 1971). The three coldest months are therefore desirable for this study because relationships between map types and bad weather during this cold period are not so likely to be complicated by lake effects.

CHAPTER III

THE SURFACE MAP TYPES

3.1 Developing the Basic Types

The surface map types for the Mackenzie window were developed using the techniques of the Map-Typing Project Office in Colorado Springs. In particular, the batch technique of Sabin and Nieman (1972) and the computer programs of Wold (1973) were used to derive the Mackenzie catalogue. These methods, used extensively in the generation of the CONUS and Alberta map-type catalogues, are described in detail by Kociuba (1974) in Chapter III of his M.Sc. thesis.

One month's surface pressure data for the twenty grid points in the Mackenzie window were used to correlate all 122 maps from 1954-1971 with each other. The formula for the product-moment linear correlation coefficient (r) for n pairs of values is:

$$r_{xy} = \frac{\sum_{i=1}^n \{X_i - \bar{X}\} \{Y_i - \bar{Y}\}}{\left\{ \sum_{i=1}^n [X_i - \bar{X}]^2 \sum_{i=1}^n [Y_i - \bar{Y}]^2 \right\}^{\frac{1}{2}}} \quad (1)$$

The map that correlated with the largest number of maps in the 18-year sample at or above $r = 0.8$ was chosen as the key map for the first map type. That map and all others correlated with it were then removed from the sample. Of the remaining maps, the map which had the largest number of maps correlating with it became the key map for the second map type. This procedure of selection and removal was repeated until the number of maps assigned to a type became less than six. All the maps in the monthly sample were then reassigned to those particular types with which they correlated most highly at or above the threshold value of $r = 0.8$. Any map type having fewer than two percent of the total maps was eliminated as a map type. Those maps which did not correlate with any type at or above $r = 0.8$ were assigned to an uncorrelated group.

This process was repeated for each of the three coldest months. Table 2 shows the derived map types for each month, the number of maps assigned to each type initially, and the number after the reassignment procedure. The map types are listed in the order in which they were initially developed. This results in a decrease in the number of maps correlated with each type because maps correlated with a given type were eliminated from the sample as the procedure progressed.

Sabin (1974) justifies the use of the threshold value $r = 0.8$ by showing that it is a good compromise value. It results in a good overall description of pressure regimes, produces an acceptable number of uncorrelated maps, and gives an adequate description of the climatology within each type.

Table 2

Key dates of monthly and seasonal¹ map types with the number of maps before/after reassignment in the development sample (122 maps, 1954-1971).

DECEMBER			JANUARY		FEBRUARY	
Number of Types	Map Type Date	Number in each Type	Map Type Date	Number in each Type	Map Type Date	Number in each Type
1	<u>621213</u>	62/38	570122	90/62	650207	57/44
2	<u>621227</u>	53/38	690139	50/34	640217	49/37
3	<u>591222</u>	46/35	560101	42/35	<u>550225</u>	41/35
4	<u>621216</u>	32/30	<u>570124</u>	38/30	<u>640222</u>	30/32
5	<u>561211</u>	31/17	<u>610108</u>	30/32	600202	25/31
6	681221	23/26	550111	28/26	600223	19/20
7	681223	18/20	650126	19/26	540211	17/17
8	<u>561219</u>	16/14	590128	15/26	690207	16/20
9	<u>601203</u>	13/17	540101	14/15	590206	12/13
10	<u>621224</u>	11/11	590131	11/21	610217	11/11
11	<u>571230</u>	11/23	710108	10/16	600210	10/11
12	<u>661205</u>	10/11	680105	10/11	<u>560210</u>	10/11
13	<u>551209</u>	10/14	550115	10/11	<u>650211</u>	9/10
14	<u>671204</u>	8/12	540102	9/11	580213	9/10
15	<u>631221</u>	8/20	610131	8/19	<u>680207</u>	8/9
16	<u>621222</u>	8/20	640120	7/10	<u>570210</u>	8/9
17	<u>611219</u>	8/11	600103	6/9	<u>680219</u>	6/6
18	<u>601219</u>	7/7	560117	6/7	<u>630216</u>	6/16
19	<u>701203</u>	6/7	550124	6/8	<u>600216</u>	6/7
20	<u>591227</u>	6/8	<u>550113</u>	6/6		
21	<u>551215</u>	6/13				
22	541227	6/7				
Uncorrelated		158		143		159
Total Maps		557		558		508

¹The final seasonal map types are underlined.

As would be expected, the reassignment procedure reduced the number of maps assigned to the more numerous types and increased the number assigned to most of the less numerous types. There was little change in the order of predominance of the more numerous types, but there were substantial changes in the order of those types which were initially not very frequent. For example, Map Type 18 in February became the ninth most frequent type after reassignment, and Types 15 and 16 in December moved up to seventh in the order of frequency.

To obtain the cold-season types, all 61 monthly map types were correlated with each other using the correlation coefficient threshold of $r = 0.8$. The correlation procedure was the same as that used previously, except that there was no reassignment step, and those maps not eliminated in the initial assignment were designated as final seasonal map types. This procedure resulted in 24 cold-season map types, and the respective key dates for these types are underlined in Table 2. The key date of each map type and the corresponding grid-point pressure values are listed in Appendix 1.

3.2 Assigning Maps to Map Types

After the surface pressure data had been corrected and the data base expanded to include 1972 data, each of the 3814 00Z and 12Z maps were correlated with the 24 map types. The maps were assigned to the map type with which they correlated most highly at or above $r = 0.8$. If the maximum correlation coefficient between a given map and all of the types was less than the threshold value, then the map was

assigned to a group of maps designated as uncorrelated Map Type U. The common feature of these maps is their non-conformity with any of the 24 map types. For this reason they are treated as a distinct group of their own so that Map Type U becomes the 25th 'map type'.

Of all the maps assigned, 34 percent had a maximum correlation coefficient less than $r = 0.8$. This is a relatively high proportion of Map Type U, compared to the 20-30 percent of uncorrelated maps in the catalogues developed by the Map-Typing Project Office in Colorado Springs. The proportion of uncorrelated maps can easily be reduced by lowering the threshold correlation coefficient used in the assignment procedure. The use of threshold values of $r = 0.75$ and $r = 0.70$ resulted in the reduction of uncorrelated maps to 21 and 13 percent, respectively.

Lowering the threshold value of r reduces the average correlation coefficient of all maps assigned to a particular type, thereby 'diluting' the distinctiveness of each set of map types. This will only be a problem in this study if the distinctiveness of the weather associated with each set of map types is also blurred. Verification tests were performed on the probability forecast model to assess the effects of using map-type data assigned at the threshold levels of $r = 0.75$ and $r = 0.70$. The uncorrelated maps were included as predictors during these tests. The verification results of these ceiling and visibility forecasts will be examined in Chapter VI.

No attempt was made to test the model using map types assigned at thresholds higher than $r = 0.8$ because of the undesirability of increasing the proportion of uncorrelated maps. Any such

increase would be at the expense of the maps assigned to the 24 correlated types. This reduction in numbers would result in a decrease in the reliability of the probability statistics derived from the 24 map-type predictors.

Increasing the data base by combining monthly data into a relatively uniform season was the most obvious way to increase the reliability of the probability statistics. Another way to increase the number of hourly observations associated with a given map type was to consider an additional type when a map is correlated above $r = 0.80$ with two maps and the difference between the correlation coefficients is small. In such cases the hourly data are associated with both types. It was arbitrarily decided by the Map-Typing Project Office to follow this procedure when the second-highest correlation coefficient was within 0.05 of the highest correlation coefficient. This procedure was followed in this study. The effects of using map-type predictors based on this artificially expanded data base are assessed in Chapter VI.

The complete results of the map-type assignment procedure are listed in Appendix 2. The dates of each map are listed in chronological order, followed on the same line by the highest correlation coefficient and associated map type resulting from the correlation between the map and the 24 map types. An "S", "M" or "W" attached to the map type designator classifies the average pressure gradient of the map as being strong, medium or weak, respectively. Listed next, and on the same line, is the second-highest correlation coefficient. It is followed by the associated map type if $r \geq 0.8$. When the second map type is listed and the difference between the

highest and second highest correlation coefficient is less than or equal to 0.05, the second map type is marked with an asterisk (*).

If the map is of Type U, a group of asterisks takes the place of the second highest correlation coefficient, followed by the map type with which Type U correlates most highly. This pertinent feature regarding uncorrelated maps was unfortunately omitted from the map-type catalogues developed by the Map-Typing Project Office.

CHAPTER IV

MAP-TYPE CHARACTERISTICS

4.1 Map-Type Occurrence Statistics

The individual occurrence statistics for each map type, including the uncorrelated maps, are given in Appendix 3. At the top of each page is an actual, dated surface weather map showing the isobaric configuration of the key map. All of the maps in each type correlate most highly with the key map, and the correlation coefficient is greater than or equal to $r = 0.8$. Beneath the key map are the characteristics of the map type, stratified by season and by month. The seasonal statistics were derived from 3700 maps of synoptic patterns observed in 26 cold seasons, from the winter of 1946-47 to the winter of 1971-72. The monthly statistics for January and February 1946, and for December 1972 are not included in the seasonal characteristics, but are included in the monthly characteristics. The correlated map types in Appendix 3 are numbered and listed in the order of their frequency of occurrence during the cold season. The uncorrelated maps of Map Type U have their characteristics listed on the last page of the appendix. The predominance of un-

correlated maps is consistent through each month of the cold season, with the highest percentage (36 percent) occurring during December. The frequencies of occurrence of the predominant correlated types will now be discussed.

Map Type 1 is the predominant type throughout the cold season, with a frequency maximum of 13 percent in January. This compares with seven percent in December and eight percent in February. Since January is the coldest winter month, it is not surprising that the most frequent map type is one which features a cold Arctic high-pressure ridge paralleling the Mackenzie River Valley from the Beaufort Sea into northeastern Alberta.

A low-pressure system located in the Gulf of Alaska is a very common synoptic situation during the winter months. When this low is well developed and located in the northeastern part of the Gulf, the Mackenzie Valley Arctic ridge is often forced eastward into the District of Keewatin. This synoptic development results in a southeasterly pressure gradient over the Mackenzie Valley, the Yukon and eastern Alaska. Map Type 2 has this isobaric configuration. It occurs consistently about seven percent of the time throughout the cold season. In December and February it slightly exceeds the frequency of Map Type 1.

Map Types 3 and 4 have nearly identical frequencies of occurrence throughout the cold season, and follow a monthly occurrence pattern similar to Map Type 1. They both have frequencies of five and three percent, respectively, in December and February, and maximum monthly occurrences of eight percent in January. Both map patterns are dominated by Arctic high-pressure centers, which may account for

their relatively high occurrence frequency in January. The high-pressure area in Type 3 is centered just southwest of Norman Wells while Type 4 has a high centered over the Yukon, just north of Whitehorse.

Map Type 5 has a trough of low pressure extending along the Arctic coast from a low-pressure system over Alaska. This configuration produces a southwesterly flow over most of the window, with a resultant influx of mild air south of the trough. As would be expected, this type is predominant in December, the mildest of the three cold months.

The five most frequent types account for nearly one-third of all the occurrences in the 26 winters. Despite the fact that the three months are well within the winter season, there are changes in the map pattern occurrences that are climatically consistent with the advance of the season.

4.2 Annual Variability in Map-Type Occurrences

Map types show considerable variation in frequency of occurrence from year to year, as can be seen by examining Table 3, which shows the maximum annual anomalies of seasonal and monthly occurrences for all types. The absolute differences between the percent frequency for a given year, and the averages over all 27 years, were compared for each map type. Those types with the greatest absolute differences are listed in Table 3. This method of determining anomalies was chosen because it highlights the characteristics of the more frequently occurring types. Occasionally, though, a type

Table 3

Maximum annual anomalies of seasonal and monthly occurrences¹

Year	Season	December	January	February
1946			6-16.1 (3.7)	6-17.8 (5.8)
46-47	10- 6.6 (2.3)	1-16.1 (7.1)	16- 9.7 (2.0)	10-10.7 (3.1)
47-48	U-40.0 (34.1)	2-29.0 (7.3)	U-54.8 (31.8)	4-20.7 (2.9)
48-49	U-45.0 (34.1)	U-48.4 (35.6)	5-16.1 (4.2)	3-10.7 (3.2)
49-50	1-20.0 (9.3)	3-19.4 (4.7)	4-29.0 (7.5)	11-10.7 (1.9)
50-51	U-42.5 (34.1)	18- 9.7 (1.4)	6- 9.7 (3.7)	3-10.7 (3.2)
51-52	7-11.4 (4.2)	4-19.4 (5.2)	7-22.5 (4.3)	6-20.7 (5.8)
52-53	18-11.3 (1.4)	2-12.9 (7.3)	1-25.8 (12.8)	18-14.3 (1.8)
53-54	1-15.0 (9.3)	6-22.6 (5.2)	1-22.6 (12.8)	1-17.8 (7.7)
54-55	7-12.5 (4.2)	13-12.9 (1.6)	2-16.1 (5.5)	7-21.4 (5.6)
55-56	4-12.6 (5.1)	U-41.9 (35.6)	4-17.7 (7.5)	U-43.1 (34.8)
56-57	U-26.4 (34.1)	3-13.1 (4.7)	3-23.0 (7.8)	1-21.4 (7.7)
57-58	2-13.3 (6.8)	6-19.4 (5.2)	2-17.7 (5.6)	7-16.1 (5.8)
58-59	1-23.3 (9.3)	1-19.4 (7.1)	1-37.1 (12.8)	U-46.4 (34.8)
59-60	1- 3.8 (9.3)	5-14.5 (6.3)	1- 6.5 (12.8)	6-15.5 (5.8)
60-61	8-10.0 (2.7)	20- 9.7 (0.8)	6-22.6 (3.7)	9-14.3 (3.2)
61-62	2-11.3 (6.8)	17- 9.7 (1.1)	7- 0.0 (4.3)	U-21.4 (34.8)
62-63	U-29.4 (34.1)	U-25.8 (35.6)	20- 7.9 (0.8)	10-12.5 (3.1)
63-64	U-40.7 (34.1)	8-16.1 (3.2)	U-41.9 (31.8)	7-13.8 (5.8)
64-65	3-12.7 (5.3)	U-48.4 (35.6)	U-22.6 (31.8)	3- 7.1 (3.2)
65-66	U-41.6 (34.1)	5-11.3 (6.3)	U-45.2 (31.8)	11- 7.1 (1.9)
66-67	1- 3.3 (9.3)	11-16.1 (3.2)	4-16.1 (7.5)	1- 1.8 (7.7)
67-68	U-41.2 (34.1)	15-11.3 (2.0)	U-55.8 (31.8)	7-10.3 (5.8)
68-69	5- 9.3 (5.1)	23- 8.1 (0.5)	3-16.1 (7.8)	2-21.4 (7.8)
69-70	2-11.1 (6.8)	8- 9.7 (3.2)	1-25.8 (12.8)	U-44.6 (34.8)
70-71	1-13.8 (9.3)	1- 1.6 (7.1)	1-27.4 (12.8)	6-14.3 (5.8)
71-72	4-13.2 (5.1)	2- 1.6 (7.3)	4-19.4 (7.5)	1-19.4 (7.5)
1972		4-19.4 (5.2)		

¹The format under each time period is as follows:

Map Type - Percent Frequency (Average Percent Frequency over all years).
 Negative occurrence anomalies are underlined.

that has a low frequency will appear as the maximum anomaly. Map Type 18, for example, occurred with a frequency of 11.3 percent in the 1952-53 cold season, which is about eight times higher than its average frequency of 1.4 percent.

The two most frequent patterns, Type U and Type 1, are also the dominant anomalies: they both occurred 13 times as monthly anomalies. Moreover, on a seasonal basis, Type U appears as an anomaly eight times, and Type 1 six times. These two types predominate to an even greater extent those maximum anomalies that arise due to a frequency that is much lower than average. These negative-occurrence anomalies are underlined in Table 3.

The highest frequency anomaly appeared in January, 1968, when Type U occurred some 56 percent of the time. Of the correlated maps, Type 1 had the highest anomaly when it occurred with a frequency of some 37 percent in January, 1959. This was almost three times its average value of 13 percent and the difference from the average was the largest of any map type including Type U. Types 1 and U also had the highest seasonal anomalies for correlated and uncorrelated types; 23 percent in 1958-59 and 45 percent in 1948-49, respectively.

Map Type 23 had the maximum anomaly - the greatest increase relative to its average frequency - with an eight percent occurrence in December, 1968. This is 16 times higher than its monthly average of 0.5 percent. The most anomalous season was 1958-59 with summed absolute differences for the season and the individual months equalling 62.2 percent. In the least anomalous season, 1946-47, the sum of the differences equalled 28.6 percent.

The season with the greatest variety of map types was 1965-66, when all types except Type 24 occurred at least once. This season also had a very high frequency of uncorrelated maps (42 percent). This suggests that the 1965-66 season was characterized by frequent changes in the pressure patterns with a minimum of map-type persistence. Clearly the persistence of map types affects the variability of their occurrence frequencies; this relationship is examined in the next section.

4.3 Map-Type Persistence

The degree of persistence of individual map types can be determined by examining the *most frequent duration* characteristic, a quantity listed in Appendix 3. The term *persistence* is used to denote two or more consecutive occurrences of a map type which has been assigned at 12-hourly intervals, using a threshold correlation coefficient of $r = 0.8$. The persistence information is based only on 15 to 16 years of data when both 00Z and 12Z data were available. It should be noted that the frequency of consecutive occurrences is the percent frequency of groups (1, 2, 3 ... etc.) of occurrences, not the percentage of maps that fall within a group. This form conveniently gives the percent probability of consecutive occurrences after a given initial occurrence. This is useful prognostic information.

Over the entire season, Map Type 1 is the most persistent configuration, appearing as a group of two or more consecutive occurrences 53 percent of the time. Map Types 4, U, 2, 3, 5 and 6

are the next six most persistent types. It is no coincidence that these most persistent types are also among the most frequently occurring types. The good relationship between frequency and persistence is further substantiated by the fact that Map Types I and U share the longest run of 11 consecutive occurrences. However, this relationship is not exact and, in the case of less frequently occurring types, the correspondence is poor. Map Type 11, for example, is the 19th most persistent type, and Map Type 22 is the 15th most persistent type.

The persistence of all map types combined can best be examined by considering the percentage of maps that fall into a group of two or more consecutive occurrences. For those years when 00Z and 12Z data were available, some 65 percent of the maps appear in sequences of two or more consecutive map-type occurrences. The random probability of two consecutive occurrences is 14.6 percent compared with the actual frequency of 27.2 percent. Synoptic map patterns are, therefore, persistent features over the Mackenzie Valley during the coldest winter months.

Each of the seven most persistent types appears at least three times as a maximum anomaly, as shown in Table 3. Despite this good correspondence, not all occurrence anomalies are associated with a persistent map type. Thus, Type 18 is the least persistent, appearing as a single occurrence 90 percent of the time. In February, 1953, it occurred four times, all non-consecutively; this is the maximum anomaly for February. The non-persistence of Type 18, and its relationship to map-type sequences is discussed in the next section.

4.4 Sequences of Map Types

In Appendix 3, the types most frequently following each of a given map type are listed in order of their frequency of following occurrence. To glean information on a sequence of more than two 12-hourly occurrences, the following-type information on a particular, most frequently following type should be consulted.

Two features of the following-type data are prominent and generally consistent with previous remarks. Map Type U is the most frequently following type for 13 of the 25 seasonal map types. This appears reasonable in view of the very high frequency of occurrence of uncorrelated maps. Ten of the twelve remaining map types follow themselves most frequently. Included in these 10 types are the seven most persistent types mentioned in the previous section. This is entirely consistent with the conclusion that the surface map patterns are very persistent during the cold season.

A different explanation is required to account for the uncorrelated maps being relatively more predominant as a following type, than as an occurring type. In the light of the findings of the preceding paragraph, it can be concluded that only two map types evolve frequently into another correlated map type. Ninety-two percent of the types most frequently persist or are followed by an uncorrelated map. This general pattern of synoptic evolution is in agreement with Burns' (1970) climatic study of the Mackenzie Valley. He found that the cold dome of Arctic air that prevails over the valley during winter forms a block to the migrating frontal lows. This blocking action would seem to account for the high persistence of map types,

and the limited degree of map-type evolution.

The highest frequency of following occurrence is 60 percent when Type U follows Type 23. This map type follows itself 27 percent of the time and, therefore, only evolves into another correlated type 13 percent of the time. This behavior is not unexpected because the key map shows no closed pressure center, but only a broad trough extending north over Great Slave Lake, and northwest to the Mackenzie delta. This configuration also has one of the lowest average pressure gradients of all the correlated types.

The second-highest frequency of following occurrence (52 percent) is ascribed to Map Type 2, following Type 18. From the key map, this sequence shows a low-pressure center moving southeastward out of northeastern Alberta. A high-pressure center over Banks Island moves southward while an associated ridge builds in behind a migrating low. It is significant and appropriate that Type 18, the least persistent of all, also appears in the most frequent map-type sequence.

4.5 Mean Pressure Characteristics of Map Types

One of the most significant aspects of the correlation method of selecting map types is that the maps assigned to a type are only similar in respect to their isobaric configurations and direction of flow patterns. Scholefield (1973) showed that the correlation coefficient between two maps of identical configuration does not change when one of the maps is altered with respect to its pressure gradient or its overall pressure magnitude. This characteristic will

become evident during the analysis of gradients and mean pressures.

During the map-type assignment procedure, the average of the MSL pressure values at the 20 grid points was calculated for each map. After the maps were assigned, the mean values for each map within a type were averaged. These mean map-type pressures, minus 1000 mb, are listed with the map-type characteristics in Appendix 3.

Map Types 20, 23 and 24 have the highest mean pressure, all being very close to 1026 mb. A quick glance at the key maps shows Map Types 20 and 24 to be dominated by high-pressure centers and ridges. The reason for the high mean pressure is not obvious in the Type 23 key map, where a low pressure trough appears to be the major feature. Type 23 is a good example of how much the magnitude and gradient of isobars within the member of a type can vary. The key map has the lowest mean pressure (1010.4 mb) of all the maps of Type 23. Its pressure gradient of 3.06 mb/grid interval is also well below the type average of 4.04. These values are in sharp contrast to the monthly mean average pressure of 1032.8 mb and mean pressure gradient of 4.29 mb/grid interval of the six Type 23 maps of December. The key map does show a weak high-pressure ridge extending from the Yukon into the southern Mackenzie Valley. The intensity of this ridge must be very marked in the December maps.

Map Types 3, 1 and 4 have previously been mentioned as types that are dominated by Arctic high-pressure systems. These types along with Map Type 8 are in the next-highest group of mean pressures in the range 1024-1025 mb. They all have monthly maximum pressures in January, a consequence of the intensity of the Arctic high pressure

systems in this coldest month. This expected relationship is not obvious in the group with the highest mean pressures, but their low frequencies of occurrence make the monthly statistics unreliable.

Map Type 12 has the lowest mean pressure of 1011.7 mb. The range in average pressures of maps of this type is greater than for Type 23. Thus the Type 12 map of January 22, 1960 has an average pressure of 1033 mb, while the map of January 1, 1948 has an average pressure of only 990.1 mb.

4.6 Pressure Gradients of Map Types

Over relatively uniform topography, the strength of the low-level winds is proportional to the surface pressure gradient. The gradient is also a good indicator of the intensity of nearby pressure systems. Both wind speed and pressure-system intensity are important weather elements, but the correlation procedure does not resolve such features. This is the principal weakness of this map-typing technique. To alleviate this problem it was decided to investigate the pressure gradient characteristics of map types subjectively by attempting to subdivide the maps assigned to each type according to their pressure gradients.

The absolute value of the pressure gradient can be easily calculated from grid-point pressure values using the following five-point grid formula:

$$\text{Gradient } (X_5) = 0.5 [(X_1 - X_3)^2 + (X_2 - X_4)^2]^{\frac{1}{2}} \text{ mb/gi}$$

where X_1, X_3 and X_2, X_4 refer to adjacent pairs of grid points

surrounding grid point X_5 .

The gradient about a grid point may vary considerably from point to point throughout the window. A specific gradient value was assigned to a map by averaging the absolute values of the gradients at all eight interior grid points. As part of the assignment process, the standard deviations of the grid-point pressures and the differences between maximum and minimum values were also calculated as indicators of gradient. The mean of the absolute gradient about the eight interior grid points was chosen to define map pressure-gradients because it was more comprehensive than the other indicators. The values are expressed in logical gradient units of mb/grid interval (gi) and the values may be evaluated at any one of the eight locations within the window.

It was arbitrarily decided to subdivide the map type into three classes based on the standard deviation (s.d.) of the mean gradients of all maps within a type. The mean gradients that are within one s.d. of the total map-type mean are classified as "medium". The gradients that are more than one standard deviation below the mean are classified as "weak" and those more than one s.d. above the mean "strong". The critical value of the standard deviation for each map type is listed in Appendix 1 along with the grid-point pressures for the key maps.

Appendix 3 contains the mean gradient characteristics of each type in units of mb/gi. The mean maximum and minimum gradients were calculated by taking the average of the highest and lowest values, respectively, that occurred at the eight central grid points on each map.

A singular feature of the mean gradient statistics is the generally weak gradients associated with uncorrelated maps. The mean pressure gradient of Type U maps is only 4.04 mb/gi which is the lowest. Map Type 23 also has a low value of 4.04 mb/gi, but this statistic is questionable because there were only 17 occurrences of this type. The mean minimum and maximum gradients of 1.57 and 7.03 mg/gi for Map Type U are also very low. The lowest mean gradient for any map is found on the 12Z uncorrelated map of January 17, 1961 with a value of only 0.65 mb/gi. The weak gradient characteristic of uncorrelated maps is a good reason for grouping them into a separate Map Type U.

The similarity in characteristics of Types 3 and 4 shows up also in their maximum mean gradients of 6.61 and 6.07 mb/gi, respectively. They also have the highest mean maximum gradients. The Type 4 map of 00Z, January 16, 1957 has the highest individual mean-map gradient of 15.03 mb/gi. The highest gradient present at one grid point was 22.64 mb/gi on the Type 1 map of January 15, 1957. Individual grid-point gradients of 0.0 mb/gi are also found on occasion.

The differences in gradients between map types are apparent, but they are small compared to some of the differences between the gradients within the same type. The difference between mean gradients of the relatively strong gradient Type 3 and weak gradient Type U is only 2.57 mb/gi. There are a couple of individual maps of Type 3 with gradients less than 3.0 mb/gi and several uncorrelated maps with mean gradients in excess of 10 mb/gi. These large in-type gradient differences illustrate the inability of the correlation technique to

discriminate between gradients. For this reason the map types will be stratified by gradients when testing a simple probability model relating ceilings and visibilities to map types.

CHAPTER V

RELATING YELLOWKNIFE WEATHER TO MAP TYPES

5.1 Climatic Averages and Anomalies

The characteristic climatic feature of the Yellowknife winter is the cold weather which, as noted in Chapter IV, is related to Arctic high-pressure systems. In the climatic data there is good evidence of a quantitative relationship between low temperature regimes and the occurrence of certain map types. In 1949-50, the coldest of the 26 seasons, the mean daily temperature was -23°F . As shown in Table 3, Type 1 has the maximum seasonal anomaly, while Types 3 and 4 have maximum monthly anomalies of occurrence during this coldest season. Types 1, 3 and 4 also appear as anomalies in the next four coldest seasons, in 1946-47, 1948-49, 1951-52 and 1955-56.

It is interesting that the five coldest winters occurred in the earlier part of the 26-year data period. The five-year moving averages, calculated for the entire period, show a pronounced warming trend through the 1950's. There was no obvious corresponding trend in map-type occurrences. However, the negative-occurrence anomaly of Type 1 in the 1959-60 season is significant, because it was the

warmest season, with a mean temperature of -0.9°F .

The moving averages showed no well-defined temperature trend through the 1960's, but a cooling trend developed during the last three winters of the decade. The winter of 1971-72 was one of the coldest since 1955-56, with the mean temperature dropping to -12.8°F . Associated with this cold season were maximum occurrence anomalies of Types 1 and 4.

The maximum precipitation recorded at Yellowknife during any season was 3.15 inches in 1960-61, with one-half falling in January, 1961. Referring again to Table 3, it is seen that Type 6 was the maximum occurrence anomaly during this snowy month, present some 23 percent of the time. The key map for Type 6 shows a low pressure system in northwestern Saskatchewan with an easterly circulation over Great Slave Lake, a favorable synoptic situation for precipitation.

Precipitation was recorded on 51 days of the 1957-58 season, the highest number of precipitation days in any of the seasons. A total of 2.82 inches of precipitation fell during this period, the second highest seasonal amount. Type 6 again appears in Table 3 as a maximum occurrence anomaly of 19 percent in December, when 1.27 inches of precipitation fell. Type 2 is the maximum anomaly for the month of January and the entire season. The key map for Type 2 shows the Arctic high east of Great Slave Lake, with a southeasterly flow over most of the window. A well-developed Gulf-of-Alaska low is the dominant feature outside the window. This synoptic situation favors the advection of moist, relatively mild Pacific air into the Mackenzie Valley, overrunning the dome of cold Arctic air and producing cloud

and precipitation.

Based on average conditions these pronounced anomalies indicate a fairly direct relationship between some of the map types and the weather at Yellowknife. To investigate this relationship in more depth, the hourly weather observations pertinent to each map type were examined in detail. The results of this study follow in the next section.

5.2 Relating Yellowknife Hourly Weather to Map Types

The Yellowknife hourly weather observations from January, 1953 to December, 1968 were analyzed as follows: the occurrences of weather parameters at three hours prior to map time, at map time and at three hours after map time were summed. This gives a six-hour associated weather period, centered around the time of a map-occurrence. There is also no overlap in the observations associated with types assigned at 12-hourly intervals. These 16 seasons of hourly data form the dependent data sample from which a conditional probability forecast model was developed. The three-hour interval between observations corresponds to that used in the forecast model.

The calculated statistics were based on the total number of weather-parameter occurrences associated with each type. Each category of ceiling, visibility and wind direction is treated as a separate parameter. For each type, the frequency of a weather parameter was calculated relative to the same parameter occurrence associated with other types. These relative frequencies are very strongly dependent on the number of type occurrences. The frequency of parameter occurrence relative to the map type occurrence gives a

much better indication of the association between weather and map types. This frequency was calculated by dividing the number of hourly observations of a parameter by the total number of hours associated with the corresponding map type. Such a frequency can be interpreted as the conditional probability of the parameter occurring, given a map-type occurrence.

Table 4 lists the four best associations for 11 weather parameters. In the center of the table are the parameter descriptions, including the total number of parameter occurrences and climatic frequency over the 16-year period. Listed to the right are the number of hourly parameter occurrences, the frequencies relative to the parameter and those relative to the associated map type. The statistics describing each associated map type are listed on the left side of the Table. The statistics on each parameter are listed in the order of the degree of association with the related type, as measured by the frequency relative to the type.

5.3 Ceilings, Visibilities and Precipitation

Ceilings and visibilities below VFR limits, and precipitation are the most significant aviation weather parameters; they are also most difficult to forecast. Frequently these three "poor-weather" elements occur simultaneously with certain synoptic situations. Map Type 6 provides a good example: it shows a relatively high degree of association with all three elements. Indications of this "poor-weather" association with Type 6 appeared previously in section 5.1 during the analysis of climatic anomalies.

Table 4

Significant weather parameter - map-type associations, based on Yellowknife hourly weather observations at all map times and at three hours before and after, during 16 years, 1953-1968.

Map Type	Num	Freq ¹	Weather Parameter	Num	Wea. Freq ¹	Type Freq ¹
14	48	1.9	Low Ceilings	24	4.9	16.7
6	105	4.3	(<1000 ft)	45	9.2	14.3
11	51	2.1	Total Num = 488	17	3.5	11.1
5	130	5.3	Clim Freq = 6.6%	43	8.8	11.0
6	105	4.3	Low Visibilities	48	9.7	15.2
12	48	1.9	(<3 miles)	21	4.2	14.6
17	48	1.9	Total Num = 495	17	3.4	11.8
11	51	2.1	Clim Freq = 6.7%	17	3.4	11.1
19	33	1.3	Precipitation	65	2.4	65.7
6	105	4.3		193	7.2	61.3
15	46	1.9	Total Num = 2680	82	3.1	59.4
13	49	2.0	Clim Freq = 36.2%	84	3.1	57.1
24	8	0.3	High Ceilings	24	0.4	100.0
23	12	0.5	(≥ 5000 ft)	35	0.6	97.2
16	40	1.6	Total Num = 5570	113	2.0	94.2
10	54	2.2	Clim Freq = 75.3%	149	2.7	92.0
20	20	0.8	Good Visibilities	60	0.9	100.0
10	54	2.2	(≥ 6 mi)	160	2.5	98.8
24	8	0.3	Total Num = 6357	23	0.4	95.8
3	127	5.1	Clim Freq = 85.9%	351	5.5	92.1

continued ...

¹Frequencies are given as percentages

Table 4 continued:

Map Type	Num	Freq ¹	Weather Parameter	Num	Wea. Freq ¹	Type Freq ¹
1	209	8.5	Wind > 12 MPH	279	18.8	44.5
11	51	2.1		64	4.3	42.4
12	48	1.9	Total Num = 1487	56	3.8	38.9
3	127	5.1	Clim Freq = 20.1%	134	9.0	35.2
19	33	1.3	North Winds	77	3.8	77.7
23	12	0.5	(NNW-NE)	25	1.2	69.4
13	49	2.0	Total Num = 2024	92	4.5	62.6
7	107	4.3	Clim Freq = 27.3%	184	9.1	57.3
11	51	2.1	East Winds	141	5.4	92.2
12	48	1.9	(ENE-SE)	123	4.7	85.4
2	169	6.9	Total Num = 2600	430	16.5	84.8
15	46	1.9	Clim Freq = 35.1%	116	4.6	84.1
5	130	5.3	South Winds	120	21.0	30.1
17	48	1.9	(SSE-SW)	37	6.5	25.7
4	111	4.5	Total Num = 571	81	14.2	24.3
14	48	1.9	Clim Freq = 7.7%	23	4.0	16.0
3	127	5.1	West Winds	321	17.2	84.3
10	57	2.3	(WSW-NW)	113	6.1	69.8
1	209	8.5	Total Num = 1866	384	20.6	61.2
20	20	0.8	Clim Freq = 25.2%	37	2.0	61.2
17	48	1.9	Calm Winds	16	4.7	11.1
8	67	2.7		18	5.3	9.4
16	40	1.6	Total Num = 340	10	2.9	8.3
4	111	4.5	Clim Freq = 4.6%	24	7.1	7.2

Low visibilities and ceilings seem to be related in the synoptic situations of Type 11, because both elements occur together some 11 percent of the time with Type 11 regimes. The key map for Type 11 has a weak trough extending into the southern Mackenzie Valley from a low-pressure center just north of Banks Island. The resulting southeasterly flow over Yellowknife is conducive to the development of low ceilings and visibilities. The key map of Type 14 also shows a southeasterly flow over Yellowknife. In this case the trough runs along the 60th parallel from an Alaskan Gulf Low. Type 14 regimes produce low ceilings 16.7 percent of the time, which is the highest frequency of low ceilings associated with any type (see Table 4).

Despite the association between the "poor-weather" elements, the precipitation frequencies are much greater than the low-ceiling and visibility frequencies. This suggests that much of the precipitation falls from higher clouds or the intensity is low. This precipitation characteristic can be attributed to the predominance of the Arctic air which is usually very dry. Influxes of milder, moist air into the region are forced to rise over the cold Arctic dome, forming clouds above the Arctic inversion. Some of the precipitation that is released from these clouds may never reach the ground due to sublimation in the dry Arctic air.

Fresh southward surges of Arctic air through the Mackenzie Valley and into Alberta are often accompanied by extensive areas of cloud and light snow, especially north of the Arctic Front. The Type 19 key map is a good example of this synoptic situation. Some 66 percent of the observations associated with Type 19 reported

precipitation. Types 13 and 15 are two other precipitation types listed in Table 4. Their key maps show a similar easterly circulation pattern over Great Slave Lake. Air-mass convergence and over-running of moist air from low-pressure systems in northern Alberta account for the high association of precipitation with regimes of Types 13 and 15.

The predominance of "good weather" at Yellowknife during the cold season is clearly indicated by the high climatic frequencies of 75.3 and 85.9 percent, respectively, for high ceilings and good visibilities. Some of the map types whose key maps are dominated by high pressure systems have considerably higher frequencies of good weather associated with them. Table 4 shows that both Map Types 24 and 20 have 100 percent of their associated observations in the highest ceiling and visibility categories, respectively. The other types listed are associated with high-category observations in excess of 90 percent of the time. Map types are, therefore, much better discriminators of "good weather" than "poor weather".

5.4 Winds

Strong winds are a significant aviation weather parameter. Table 4 shows that wind speeds greater than 12 miles per hour occur less frequently than precipitation, but more frequently than low ceilings and visibilities. As is the case for all parameters listed in the table, the frequency of the parameter associated with given map types is considerably greater than the climatic frequency. The most significant feature of this section of the table is the presence

of Types 1 and 3. Their association with strong winds is undoubtedly related to their previously described strong pressure gradients. The converse relationship between weak gradient map types and calm winds is not pronounced.

All maps belonging to a given type have very similar flow patterns. This is clearly illustrated by the high degree of association between map type and wind direction. Table 4 shows that 92 percent of the observations grouped with Type 11 have easterly winds. The other wind directions also exhibit high degrees of association with specific map types, with the possible exception of south winds which have a low climatic frequency of only 7.7 percent.

The absence of Type U from Table 4 shows that there are no weather parameters that are highly associated with uncorrelated maps. Most of the associations in Table 4 show the parameter frequencies of occurrence with map types to be greater than twice the climatic frequencies of these parameters. This suggests close relationships between map types and synoptic weather. The next chapter will examine the possibilities of using these relationships to predict weather in an independent data sample.

CHAPTER VI

PREDICTING CEILINGS AND VISIBILITIES AT YELLOWKNIFE BASED ON MAP TYPES

6.1 Developing the Probability Forecast Model

The computer program that determined the association of weather parameters with map types also calculated and stored for future use the probabilities of occurrence of the associated parameters over the 16-year dependent data period. These conditional probabilities were determined for 11 separate times associated with each map-type occurrence. The times were at three-hourly intervals; from six hours prior to map time up to 24 hours after a map type occurrence. Separate calculations were made for those observations associated with 00Z maps, 12Z maps and combined 00Z and 12Z maps. Climatic probabilities were also calculated using the identical procedure. For all climatic calculations, the hourly data were stratified only according to the hour of the map occurrence and the associated times before and after map time.

The basic statistical characteristics of the dependent data base are depicted in Table 5. They pertain to the 2467 hourly observations made at map time. An identical number of observations

Table 5

Number of occurrences and climatic probabilities of ceiling and visibility categories at 00Z and 12Z for the months of January, February and December 1953-1968.

Category	00Z		12Z		00Z + 12Z	
	Num	% Prob	Num	% Prob	Num	% Prob
Ceiling A	11	1.1	48	3.3	59	2.4
Ceiling B	41	4.0	55	3.8	96	3.9
Ceiling C	185	18.1	277	19.2	462	18.7
Ceiling D	<u>786</u>	<u>76.8</u>	<u>1064</u>	<u>73.7</u>	<u>1850</u>	<u>75.0</u>
Total	1023	100.0	1444	100.0	2467	100.0
Visibility A	17	1.7	29	2.0	46	1.9
Visibility B	56	5.5	62	4.3	118	4.8
Visibility C	70	6.8	123	8.5	193	7.8
Visibility D	<u>880</u>	<u>86.0</u>	<u>1230</u>	<u>85.2</u>	<u>2110</u>	<u>85.5</u>
Total	1023	100.0	1444	100.0	2467	100.0

are used to calculate probabilities at each of the other ten times associated with map types. The gaps in the 00Z map-type data result in there being fewer observations associated with 00Z.

Slight diurnal influences on the ceilings and visibilities can be detected by examining their probabilities of occurrence. Observations at 12Z have a greater percentage of the "poor" weather in category A than do the 00Z maps. Good weather in category D, on the other hand, occurs more frequently associated with 00Z maps. The infrequent occurrences of category A are the principal reason why no additional category or monthly stratification was introduced into the model. Because of the significance of this weather category to

aviation, it is desirable to have the related statistics as stable as possible.

6.2 Testing the Forecast Model

Once the probability statistics were calculated for all types, the results were used to forecast ceiling and visibilities according to the prevailing map type. Four years (1969-1972) of map-type data and Yellowknife hourly weather were used as the independent data sample to test the forecast model.

The main difficulty in verifying probability forecasts by using standard contingency methods is converting the probability forecasts to a categorical forecast. For example, it is difficult to determine which ceiling category will be forecast, given the probability forecasts for each of the four categories. One solution is to assign to each category a weight in proportion to the relative significance of accurately forecasting the category. Each categorical probability forecast is multiplied by its respective weight, and that category with the highest weighted probability becomes the categorical forecast.

One verification method that indirectly incorporates a weighting scheme is the Brier P-score, specifically developed to verify probability forecasts. The weighting is accomplished by raising the score of a group of categorical forecasts whose probabilities are not distributed ideally into one categorical forecast of 100 percent and the remainder into zero percent. If this measurement of the resolution of a forecast was the only criterion used in determin-

ing the score, then efforts to improve scores would likely lead to probability forecasts being either too high (overforecasting) or too low (underforecasting). To account for these possibilities, a further penalty is added when the probability of the forecast category does not correspond to the frequency of the category's occurrence. When there is little difference between the forecast probabilities and the frequency of category occurrences, the forecast is said to be reliable.

The resolution and reliability components of the P-Score are not at all obvious in the original formula developed by Brier (1950). The P-score formula is thoroughly analyzed in Appendix 4, where it is transformed into a formula which can be used to verify individual category forecasts, rather than a complete group of categorical forecasts. The transformed Brier Score formula for N forecasts of an event or category is¹

$$B = \frac{1}{N} \sum_{k=1}^n M_k [(f_k - \phi_k)^2 + \phi_k(1 - \phi_k)] , \quad (2)$$

where k refers to one of n probability classes and f_k is the probability that represents each class. In this study, 11 classes cover the full range of probabilities. Representing the lowest class of probabilities, from 0-4 percent, is $f_1 = 0.0$; the next highest class from 5-14 percent is represented by $f_2 = 0.10$... etc. and the highest range of probabilities, from 95-100 percent, is represented by $f_{11} = 1.00$.

The first term within the brackets of Equation (2) is the reliability term, while the second is the resolution term, and ϕ_k is

¹See Appendix 4

the frequency of the event relative to the number of event forecasts. The maximum score of zero occurs when the event probability and relative frequency are both equal to zero percent or 100 percent. The worst score possible is $B = 1$.

A root-mean-square error in reliability can be defined from the reliability term in Equation (2) as

$$RMSE = \frac{100}{N} \sum_k^n M_k (f_k - \phi_k)^2 . \quad (3)$$

The RMSE is used in this study to monitor the effect of reducing the number of event occurrences through increased stratification of the data. Good reliability results from having a suitably large number of events in a sample so that the probability statistics are stable.

Brier Score verification was also applied to the independent data forecasts that were made using the climatic probabilities. These climatology scores are compared with the scores calculated from the forecasts made using map-type-stratified conditional probabilities. If both scores were calculated on forecasts of the dependent data, then the map-type-stratified forecasts would always show an improvement over purely climatological forecasts. This will not necessarily be the case for map-type-stratified forecasts of independent data, for two reasons: first, there is no guarantee that the climatology of the independent data is going to be the same as the dependent data. Secondly, assuming that there is a relationship between map patterns and weather, certain map types will be better predictors than others, depending on the strength of the relationship. It is conceivable that a map type that is a relatively poor predictor will produce a

Brier Score that is worse than a climatology forecast score, when the forecasts are made on independent data.

It can be seen that the Brier Score is an ideal verification method for this study. It is specifically designed to verify probability forecasts, and gives a convenient measure of the forecast reliability as well as resolution. Moreover, the scores are calculated in such a manner that comparisons can readily be made with respect to different models, map types, weather elements and categories. One of the disadvantages of the method is that it gives no suitable measure of the effectiveness of a forecast that is to be used operationally. However, the concern of this thesis is to examine possible methods that could be used in the development of an operational model. When the model appears to be suitable for operational use, then some measure of its operational effectiveness should be determined.

6.3 The Verification Program

A computer program was developed for verifying four categorical forecasts at a time, using cold-season data for four years. The input data consisted of 660 maps at all 00Z and 12Z map times, 7986 hourly Yellowknife weather observations, climatic probabilities and conditional probabilities of the four category occurrences. The program progresses chronologically through the independent data, recording the number of times each category occurred and was forecast, the probability class in which the correct forecast was made, and for which of the 11 associated times the forecast was valid.

The results for each category were stored in a four-dimensional array, with each element of the array containing, in one computer word, the total number of forecasts and the number of correct forecasts. The four dimensions of the array correspond to the map time, the associated map-type time, the map type and the category. The Brier Scores were calculated from the storage arrays, and the results were listed in 33 tables. The tables are organized into three sets of 11 tables, for the 00Z, 12Z and combined map times, respectively. The tables in each set contain results for the 11 times associated with each map type.

Table 6 shows a typical verification table containing results for ceiling forecasts valid at map time for all 00Z and 12Z maps. The average results for each category were calculated by weighting each score according to the number of related map types. This is equivalent to weighting the scores according to the number of forecasts in each probability class as indicated in Equation (2), because each map-type score is based on only one probability class. For the purpose of comparison, the scores for climatology forecasts are listed immediately below the average scores.

Some characteristics of the scores given in this table require explanation. It has been stated that lower P-Scores indicate better forecasts. It would appear from Table 6 that the relatively rare category-A events are forecast more accurately than the more frequent category-D events. This can be explained by recalling that the best scores are given to those accurate category forecasts close to the limiting values of zero or 100 percent. All category-A probability forecasts score very close to zero, and since this

Table 6

An example of the verification results for one of 11 times associated with all map types and a summary of the set of 11 verification tables.

P-SCORES AND RELIABILITIES BASED ON ALL MAPS FOR CEILING FORECASTS AT MAP TIME + (0) HOURS

TYPE	CIG-A		CIG-B		CIG-C		CIG-D		AVERAGE	
	P-SCORE RLBY (%)		P-SCORE RLBY (%)		P-SCORE RLBY (%)		P-SCORE RLBY (%)		P-SCORE RLBY (%)	
4	0.049	0.24	0.0	0.0	0.088	0.00	0.095	1.19	0.058	0.36
8	0.063	0.11	0.0	0.0	0.0	0.0	0.107	0.79	0.042	0.23
1	0.0	0.0	0.0	0.0	0.221	2.66	0.157	0.00	0.094	0.67
3	0.0	0.0	0.0	0.0	0.031	0.54	0.031	0.54	0.016	0.27
6	0.0	0.0	0.111	1.23	0.268	2.09	0.250	0.08	0.157	0.85
7	0.0	0.0	0.0	0.0	0.313	6.48	0.210	0.00	0.131	1.62
2	0.096	0.92	0.056	0.18	0.038	0.43	0.229	0.23	0.105	0.44
17	0.0	0.0	0.0	0.0	0.0	0.0	0.010	1.00	0.003	0.25
14	0.0	0.0	0.110	0.06	0.010	1.00	0.190	0.25	0.077	0.33
9	0.0	0.0	0.0	0.0	0.0	0.0	0.040	4.00	0.010	1.00
13	0.0	0.0	0.0	0.0	0.223	0.11	0.227	0.44	0.112	0.14
5	0.111	1.23	0.112	0.08	0.036	0.46	0.214	0.82	0.119	0.65
11	0.067	0.44	0.133	1.78	0.250	12.76	0.235	0.06	0.171	3.76
18	0.167	2.78	0.0	0.0	0.090	9.00	0.227	0.44	0.121	3.06
23	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.00	0.000	0.00
21	0.0	0.0	0.0	0.0	0.040	4.00	0.160	16.00	0.050	5.00
19	0.0	0.0	0.0	0.0	0.390	20.25	0.350	20.25	0.155	10.12
10	0.0	0.0	0.0	0.0	0.143	2.04	0.010	1.00	0.038	0.76
24	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.00	0.000	0.00
12	0.083	0.69	0.010	1.00	0.235	0.06	0.260	1.00	0.147	0.69
20	0.0	0.0	0.0	0.0	0.010	1.00	0.040	4.00	0.013	1.25
16	0.0	0.0	0.0	0.0	0.125	1.56	0.110	0.06	0.059	0.41
15	0.0	0.0	0.0	0.0	0.360	36.00	0.250	0.69	0.152	5.17
22	0.0	0.0	0.0	0.0	0.0	0.0	0.250	25.00	0.063	6.25
0	0.033	0.11	0.019	0.04	0.122	0.41	0.203	0.03	0.054	0.15
AVRG	0.0324	0.23	0.0266	0.16	0.1308	2.13	0.1726	0.71	0.0906	0.81
CLIM	0.0348	0.12	0.0303	0.09	0.1364	0.16	0.1530	0.18	0.0986	0.14

PERCENT IMPROVEMENT OF MAP TYPE P-SCORES OVER CLIMATOLOGY P-SCORES
AT DIFFERENT TIMES BEFORE AND AFTER THE OCCURRENCE OF ALL MAPS

TIME	CIG-A		CIG-B		CIG-C		CIG-D		AVERAGE	
	P-SCORE RLBY (%)		P-SCORE RLBY (%)		P-SCORE RLBY (%)		P-SCORE RLBY (%)		P-SCORE RLBY (%)	
	%DIFF	DIFF	%DIFF	DIFF	%DIFF	DIFF	%DIFF	DIFF	%DIFF	DIFF
-6	-20.54	-0.237	10.57	0.189	4.36	-1.200	2.57	-0.846	-0.76	-0.524
-3	-4.14	-0.161	10.08	-0.218	12.91	-0.490	4.22	-0.988	5.76	-0.464
0	6.98	-0.110	12.17	-0.065	4.07	-1.974	10.56	-0.531	8.45	-0.670
3	-12.96	-0.234	-11.15	-0.181	3.06	-1.745	9.42	-1.294	-2.91	-0.863
6	-20.80	-0.191	-45.56	-0.377	-2.78	-1.482	2.11	-0.943	-16.76	-0.748
9	9.91	-0.075	5.16	-0.444	10.26	-0.733	11.17	-1.363	9.12	-0.654
12	15.81	-0.054	-12.68	-0.257	9.19	-1.178	3.82	-0.887	5.03	-0.594
15	1.41	-0.091	3.24	-0.347	0.20	-1.777	15.44	-1.016	5.07	-0.808
18	3.40	-0.144	-13.21	-0.226	-3.19	-1.845	8.23	-1.017	-1.19	-0.808
21	12.00	-0.055	-0.21	-0.246	10.68	-0.306	5.86	-1.170	7.08	-0.443
24	7.76	-0.174	-16.12	-0.454	6.45	-1.291	6.45	-0.850	1.12	-0.592

FOR ALL MAPS, THE TOTAL AVERAGE MAP TYPE P-SCORE IS 0.0925 AND RELIABILITY IS 0.83 PERCENT
THE TOTAL AVERAGE CLIMATOLOGY P-SCORE IS 0.0974 AND RELIABILITY IS 0.17 PERCENT

category occurs very infrequently, it results in scores which are low.

When comparing scores between categories, it is more useful to consider the percent improvement of the map-type scores over the climatology scores as the measure of the forecast skill of the map-type forecast model. For example, the results in Table 6 show the map-type model as having greater skill in forecasting category D than category A, because the respective percent improvements over climatology are 10.6 and 7.0 percent.

It may also seem incongruous that category A, with the fewest occurrences, has a better reliability component than the most frequently occurring category D. Table 6 shows that the higher average reliabilities in the more frequently occurring categories are primarily due to a few very high-percent reliabilities present only with certain rather uncommon types - a factor which likely accounts for their poor reliability scores. For example, in the presence of Type 23, ceiling category C has a class frequency of 0.40, as determined from the dependent data. During the independent data period, Type 23 appeared 12 times, and each time the ceiling was in category C; this means its relative frequency in category C is 1.0. The square of the difference between the relative and forecast frequency results in a high reliability of 36 percent. The resolution component in this example is zero, so the P-Score is 0.36. The much lower number of category-A occurrences reduces the potential for high reliabilities, which explains why the average percent reliabilities are low.

Listed at the end of each set of tables is a summarization table giving the percent improvement over climatology of the category

forecasts of the 11 times associated with map types. An example of such a table is shown at the bottom of Table 6, a summary of the set from which the table above it was extracted. The bottom two lines give the overall scores and reliabilities for the set. The significance of these statistics is discussed in the next section.

6.4 Averaged Verification Results

Average verification scores were calculated over all four categories of ceilings and visibilities, and for all 11 times associated with all map types. The averages were calculated separately for forecasts based on 00Z, 12Z and combined 00Z and 12Z map times. These results, along with percent improvements over climatology, are listed in Table 7. In an attempt to improve the verification scores, the forecast model was modified in several ways. The averaged results of the modified versions of the basic model are also listed in Table 7.

The results for the basic model are listed first. The outstanding result is that map-type forecasts are a definite improvement over climatological forecasts of ceiling and visibility categories. There is, however, a significant difference in the forecast skills for ceiling and visibility forecasts. Based on all map times, the map-type ceiling forecasts are 5.03 percent better than climatology forecasts, whereas visibility forecasts are only 0.80 percent better. This discrepancy in forecast skill is understandable in view of the fact that the map-type patterns are synoptic features, and categories of cloud ceiling are more synoptic in nature than those of visibility. The best visibility forecasts are based on 00Z map times, which is

Table 7

Brier verification scores and reliabilities averaged over all weather categories, map types and 11 associated times (at three-hourly intervals) for map-type-stratified and climatology forecasts of independent data from 1969-1972.

Map Time	Weather Element	Map Type P-Score	Climat P-Score	Percent Better ⁴	Reliability (%) ⁵	
					Map Type	Climat
00Z	ceilings	0.0908	0.0953	4.72	0.91	0.14
12Z	($r^1 = 0.80$)	0.0944	0.0977	3.38	0.88	0.18
ALL		0.0925	0.0974	5.03	0.83	0.17
00Z	Visibilities	0.0972	0.0982	1.02	1.55	0.43
12Z	($r = 0.80$)	0.1009	0.1017	0.79	1.54	0.58
ALL		0.0996	0.1004	0.80	1.42	0.46
00Z	Ceilings	0.0899	0.0953	5.67	0.88	0.14
12Z	($r = 0.75$)	0.0945	0.0977	3.28	1.03	0.18
ALL		0.0915	0.0974	6.06	0.80	0.17
00Z	Visibilities	0.0978	0.0982	0.41	1.66	0.43
12Z	($r = 0.75$)	0.1004	0.1017	1.28	1.62	0.58
ALL		0.0988	0.1004	1.59	1.48	0.46
00Z	Ceilings	0.0901	0.0953	5.46	0.86	0.14
12Z	($r = 0.70$)	0.0953	0.0977	2.46	1.05	0.18
ALL		0.0916	0.0974	5.95	0.81	0.17
00Z	Visibilities	0.0976	0.0982	0.61	1.61	0.43
12Z	($r = 0.70$)	0.1006	0.1017	1.08	1.58	0.58
ALL		0.0994	0.1004	1.00	1.43	0.46

continued...

Table 7, continued:

Map Time	Weather Element	Map Type P-Score	Climat P-Score	Percent Better	Reliability (%)	
					Map Type	Climat
00Z	Ceilings	0.0907	0.0953	4.83	0.90	0.14
12Z	($r = 0.80$)	0.0944	0.0977	3.38	0.88	0.18
ALL	Expanded ²	0.0925	0.0974	5.03	0.78	0.17
00Z	Visibilities	0.0969	0.0982	1.32	1.53	0.43
12Z	($r = 0.80$)	0.1009	0.1017	0.79	1.54	0.58
ALL	Expanded	0.0985	0.1004	1.89	1.36	0.46
00Z	Ceilings	0.0967	0.0953	-1.47	2.21	0.14
12Z	($r = 0.80$)	0.0967	0.0977	1.02	2.20	0.18
ALL	Gradient ³	0.0966	0.0974	0.82	2.04	0.17
00Z	Visibilities	0.1020	0.0982	-3.87	2.73	0.43
12Z	($r = 0.80$)	0.1043	0.1017	-2.56	2.96	0.58
ALL	Gradient	0.1017	0.1004	-1.29	2.49	0.49

¹ r - refers to the correlation coefficient used in the map type assignment procedure.

²Expanded - indicates that the dependent map type data base has been expanded to include maps that have their second highest correlation coefficient greater than or equal to $r = 0.8$, and within .05 of the highest r .

³Gradient - indicates that all 25 map types have been subdivided into three pressure gradient classes.

⁴Precipitation forecasts, based on surface map types over Alberta, were on the average 6.5 percent better than climatology for 23 stations (Kociuba, 1974).

⁵The average percent reliability for precipitation forecasts for 23 stations in the Alberta window was 1.08 percent (Kociuba, 1974).

indicative of a local diurnal factor rather than synoptic factor.

It was mentioned in Section 3.2 that when maps were assigned to types using a threshold correlation coefficient of $r = 0.75$ and $r = 0.70$, there was a successive reduction in the proportion of uncorrelated maps. These two additional map-type data sets were used in the forecast model in place of the basic set of map types which had been assigned at $r = 0.80$. The averaged verification results from this procedure are displayed in Table 7. Only in the case of visibility forecasts based on 00Z maps, and ceiling forecasts based on 12Z maps, are the results worse than those of the basic model. The forecasts based on all 00Z and 12Z map types of the $r = 0.75$ data have P-Scores better than the other models, for both visibilities and ceilings. For the latter, the improvement over climatology is 6.06 percent, or more than one percent greater than the basic model results, but only slightly better than the results of the model using maps assigned at $r = 0.7$.

The P-Score improvements were not so convincing as to warrant an immediate change in the correlation threshold used in assigning maps. There is enough evidence, however, to suggest further experimentation with other threshold levels using different years of independent hourly data at Yellowknife. To determine an optimum assignment threshold for the Mackenzie window, similar experiments to those just mentioned should be applied to other observing sites within the window.

The dependent hourly data associated with secondary map types were incorporated into the calculation of conditional probabilities. If a particular map was correlated with more than one map type

at or above $r = 0.80$, and the difference between the highest and second highest correlation coefficients was within 0.05, then that map was assigned to both types. In such a case the 11 associated hourly observations are used to represent the weather related to each type. The result of applying this process to the dependent data increased the total number of map-type cases from 2467 to 2792.

The probabilities determined from this "expanded" data base were used in the forecast model. The resulting verification scores for ceiling forecasts, shown on Table 7, are essentially unchanged from the scores of the basic model. The percent reliability for ceiling forecasts based on all map times, showed a slight drop from 0.83 to 0.78, but there was no change in the P-Score; this means that the resolution components of the forecasts are not as good as for the basic model. There is some improvement in the visibility forecasts based on all map times. The average reliability improved from 1.42 to 1.36 percent and the forecast skill increased from 0.80 to 1.89 percent, a significant improvement over climatology.

It was stated in Section 4.6 that all maps within the types were subdivided into three classes of strong, medium and weak gradients. The chronological listing of map types in Appendix 2 indicates the gradient class of each map. These gradient types were used in the forecast model. The verification results are the last two sets in Table 7. The P-Scores and reliabilities are clearly the worst in the Table, with reduced skill shown for ceiling forecasts, and negative skill for the visibility forecasts.

The probability statistics for the gradient types were based on the association of hourly weather with 75 types. Tripling the

number of types greatly reduces the number of observations associated with each type, resulting in a sharp increase in the percent reliabilities. For ceiling forecasts the reliabilities jumped above the two percent level, compared to less than one percent for the basic model.

The resolution components of the P-Scores were definitely lowered, but not enough to compensate for the poor reliabilities. Consider, for example, the ceiling forecasts based on all map times. Verification of the basic model forecasts produced an average P-Score of 0.0925, the sum of a reliability component of 0.0083, and a resolution component of 0.0842. For the gradient-type forecasts the resolution component was lowered to 0.0762, but the reliability increased to 0.0204, yielding a worse P-Score of 0.0966.

The importance of reliable statistics in the development of a successful forecast model was aptly demonstrated when using pressure gradients for further stratification of the data. Two additional conclusions can be derived from the reliability statistics in Table 7. First, the percent reliabilities for visibility forecasts are consistently worse than those for ceiling forecasts. This indicates greater local variability in the occurrences of visibility related to map types. Secondly, the reliability of forecasts based on combined 00Z and 12Z map times is better than the reliability based on the individual times. This can be directly attributed to the increased number of maps in the combined map-times data sample. The improved reliabilities are one reason why the skill of ceiling forecasts based on all map times is greater than of forecasts based on the individual map times. From the Table 7 results

it may be generally stated that better reliabilities and improved P-Scores result from enlarging the stratified data bases.

6.5 Significant Results from the Detailed Verification Scores

The verification program produced a total of six summary tables, identical in format to the one shown with Table 6: one table for each of the three groups of visibility and ceiling forecasts based on the 00Z, 12Z and combined 00Z and 12Z map times. An analysis of all these tables showed no apparent trend in the skill of the forecasts for the 11 times associated with the types. However, for the three summary tables of the basic-model ceiling forecasts, the skill at map time was always greater than the skill 24 hours after map time. The relationship for visibility forecasts was not quite as good. Similar comparisons were made between the skill scores for forecast pairs at -3 and +21 hours, and at -6 and +18 hours relative to map time. For 12 of the 18 pairs in all six tables, the forecast skill was greater at the hour nearest to map time. This indicates that forecasts near map time are more skillful than forecasts 24 hours later.

A result that stands out clearly on all summary tables of the basic model verification is the fact that map-type forecasts show less skill than climatology in forecasting weather in the two below-VFR categories. For example, the ceiling forecasts of the low categories based on all map times were, on the average, 2.5 percent worse than climatology forecasts, and the visibility forecasts were 4.1 percent worse. In contrast to these results, the map-type forecasts

of the two highest categories of ceilings and visibilities were 6.1 and 0.8 percent better than climatology.

The types that showed the best relationship between low ceiling and visibility categories in the dependent data set are given in Table 4. For each of these types, the frequency of the associated low category weather was significantly greater than the climatic frequency. If this had held true in the independent data sample, the P-Scores for these types would have been lower than the climatology P-Scores. As it turned out, the frequencies of the low categories for a majority of the associated times in the independent data were closer to the climatic frequency of the dependent data, resulting in the P-Scores for climatology forecasts being better for these types than the map-type forecasts. This agrees well with the results given in the previous paragraph.

Map Type 10 was a "good" weather type in the dependent data sample, as shown in Table 4, with 92 percent of the associated ceilings and 99 percent of the visibilities in the highest weather category. This compares with 75.3 and 85.9 percent, respectively, for climatology. During the independent data period, Type 10 occurred 15 times. The P-Score for category-D ceiling forecasts related to this type is 0.0497, a score averaged over the 11 associated times, and based on forecasts at all map times. This is 73.3 percent better than the 0.1859 average P-Score for climatology forecasts. The comparable visibility forecasts have verification P-Scores of 0.0529 vs. 0.1918 for a 72.4 percent improvement over climatology forecasts.

The forecasts related to the other "good" weather types, with the notable exception of Type 24, also produce considerably better P-Scores than the climatological forecasts. Table 4 shows that during eight occurrences of Type 24 in the dependent data sample, 100 percent of the ceilings and 95.8 percent of the visibilities associated with the type are in category D. This type appeared only three times in the independent sample. During the same six-hour associated-weather period, all nine observations were in category D, which means that the P-Score for this period was a perfect zero. The forecasts at the remaining eight associated times were, however, far from perfect, giving an average verification score of only 0.2715. This was -47.6 percent worse than the average climatology P-Score for the same period. As might be expected, poor reliability was one reason for the high scores. The average reliability over the eight hours is 10.5 percent, compared with only 0.39 for climatology.

As an individual map type, the uncorrelated group of maps exhibits some interesting verification results. The averaged P-Scores for the basic model forecasts related to Type U are better than climatology for both low weather categories and the highest category. The largest improvements over climatology are for the low categories: visibility forecasts improved 6.3 percent, and ceiling forecasts 5.8 percent.

When the number of maps in Type U were lowered by assigning maps at $r = 0.70$, the skill with which Type U forecast category D was enhanced, the ability to forecast the two lowest categories was reduced, but still slightly better than climatology forecasts. More significantly, the P-Scores related to the four types best associated

with the low categories improved, and the scores related to the types best associated with highest weather category worsened. Since these results apply to both ceiling and visibilities, they are significant. This suggests that the maps removed from the uncorrelated group when the assignment threshold was lowered to $r = 0.70$ had appreciable amounts of below-VFR weather associated with them.

CHAPTER VII

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

7.1 The Surface Map-Type Catalogue

A catalogue of surface map-type patterns over the Mackenzie Valley has been developed using the computerized procedures of the USAF Map-Typing Project Office in Colorado Springs. The data consisted of 00Z and 12Z MSL pressures for December, January and February at 20 grid points in the Mackenzie window over a 27-year period from 1946-1972.

The correlation procedure produced 24 distinct map types. The first three appendices constitute the catalogue of types. The basic information used to assign maps to types is listed in Appendix 1. It includes, in Table 8, the MSL pressures at the 20 grid points for the key maps representing each type. Also listed in the table are the standard deviations of the mean pressure gradient used to assign a gradient class to each type. Appendix 2 contains a chronological listing of all maps and the assigned types. The gradient class of each map is appended to the type designator. The pressure pattern of the key map for each type is illustrated in Appendix 3. Statistical

information on the pressure and occurrence characteristics is listed beneath each key map.

The key map patterns and the mean pressure statistic clearly show the Mackenzie Valley to be dominated by high-pressure systems during the three coldest months. This was anticipated in a region with a highly continental climate. The information on occurrences indicates a high degree of map-type persistence which can be related to the predominance of the continental Arctic air mass.

Just over one-third of all maps did not correlate with any of the types during the map-type assignment procedure. This high percentage of uncorrelated maps reduced the number of maps assigned to the correlated types to such an extent that statistical reliability became a problem when relating hourly weather to individual types.

The wide range of mean pressure gradients between maps of the same type substantiates the conclusions of Scholefield (1973) who used simple hypothetical maps to show that the correlation method does not discriminate between pressure gradients. Classifying map types according to their pressure gradient produced "sub-types" with similar pressure gradients as well as isobaric configurations.

The monthly occurrence statistics in Appendix 3 indicate slight changes in map-type frequencies that can be related to the advance of the winter season. The changes do not appear large enough to prevent an expansion of the three-month cold season. Such an expansion is recommended as a means of combatting statistical reliability problems.

7.2 Yellowknife Weather Related to Map Types

A few good relationships were found between the annual occurrence anomalies of map types and the climatic anomalies of temperature and precipitation. There was no evidence of a trend in map-type occurrences associated with a pronounced cooling trend that began in the late 1940's and continued through the following decade.

The results of summarizing 16 years of hourly observations of aviation weather parameters, present near the time of map type occurrences, were encouraging. In all cases, the frequency of weather parameters relative to a given type were considerably greater than the corresponding climatic frequencies. The four map types that had the highest degree of association with a given parameter were noted. The best associations were found between map types and the highest categories of ceiling and visibility, and the wind direction. The association between types and precipitation was also fairly good. The worst associations were between map types and the lowest ceiling and visibility categories. Despite these poor associations, the best relative frequencies were still significantly larger than the climatic frequencies.

May Type U was never one of the four best types associated with a given weather parameter. This suggests that types which were highly associated with parameters should be better than Type U as a predictor of that parameter. However, verification results of low category ceiling and visibility forecasts showed this not to be the case.

7.3 Predicting Ceiling and Visibility Categories

A simple conditional-probability forecast model was developed based on the frequencies of ceiling and visibility categories associated with map types during a 16-year dependent data sample. The model was tested by calculating P-Scores on probability forecasts over four years of independent data. The skill of these map-type forecasts was measured by comparing their P-Scores with those calculated from forecasts based on pure climatological frequencies.

The overall results showed map-type forecasts to be better than climatological forecasts. Ceilings, being more often of synoptic-scale extent than visibilities, were forecast with greater skill than visibilities. Ceiling forecasts based on the combined map times of 00Z and 12Z were slightly better than those based on individual 00Z or 12Z times only. This was largely due to improved forecast reliability. Verification results of the model based on gradient-stratified map types were the worst of any model, despite improvements in forecast resolution. Over-stratification of the data was entirely responsible for these poor results.

As this study progressed, it became evident that the statistical stability of the data was the most important factor affecting the verification results. P-Scores worsen in every case where the data are stratified too much. Conversely, those stratified weather parameters that occur frequently enough to be statistically stable, are forecast relatively better than overstratified parameters. This factor explains why the map-type-stratified model does not forecast the lowest categories as skillfully as climatology. It also explains

why the low category forecasts associated with the relatively frequent Map Type U are better than those low category forecasts associated with more highly associated, but less frequent types. The excellent verification results shown by map-type forecasts of the highest weather category can be related to the statistical stability of the category-D observations.

An attempt was made to increase the number of observations associated with each type by assigning more than one type to a map when the second highest correlation coefficient was close to the first. The number of correlation types was also increased by lowering the correlation coefficient threshold during the assignment procedure. In both cases there was some improvement in the reliability and P-Scores of the forecasts.

These verification results are promising, considering that no initial weather condition is incorporated, and the only atmospheric predictor is the synoptic weather pattern. There are enough positive results to warrant further study.

7.4 Recommendations for Further Study

To improve this map-type forecast model to the stage where it could be successfully used as an objective aid to aviation forecasting, the following recommendations are made:

- (i) The model should be applied to another location in the Mackenzie window and comparisons made with the Yellowknife results.

- (ii) There is no need to alter the correlation coefficient threshold ($r = 0.8$) used in developing the map types, but the assignment threshold should be lowered to reduce the number of uncorrelated maps and improve verification results.
- (iii) The data base should be expanded by increasing the length of the season, by considering maps at the intermediate hours of 06Z and 18Z, and by obtaining additional hourly data.
- (iv) Forecast reliability could be improved by combining the two lowest ceiling and visibility categories; also consideration should be given to other significant parameters, such as precipitation and strong winds, which, essentially, have only two categories: occurrence and non-occurrence.
- (v) The data should be stratified according to an initial weather condition which introduces local effects and persistence. This should improve the forecast resolution more than the subsequent loss of reliability.
- (vi) In addition to the P-Score, the "improved" model should be verified against persistence and official FT's, using contingency table methods. A utility score should be included to measure the operational effectiveness of the forecasts.
- (vii) Gradient stratification should be considered for

select types that occur frequently enough to ensure statistical reliability.

- (viii) If the "improved" model should produce disappointing results, consideration should be given to redeveloping the map-type catalogue by incorporating derived atmospheric parameters such as vorticity and thickness.

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APPENDIX 1

SURFACE MAP-TYPE WINDOW, GRID-POINT PRESSURE VALUES AND STANDARD DEVIATIONS OF THE MEAN PRESSURE GRADIENT

The surface map type window (dashed lines) is illustrated in Figure 2 with the 20 grid points and the locations within the window for which terminal forecasts are regularly issued. The dates and grid-point pressure values of the key map for each type are listed in Table 8. The standard deviations of the mean pressure, listed in the table, were calculated from all the maps assigned to each type. The units are in mb/grid interval (381 km).

FIGURE 2. MACKENZIE WINDOW
 NUMBERED GRID POINTS REFER TO THE ORDER IN WHICH THE
 PRESSURE VALUES ARE LISTED IN TABLE 8 (SEE BELOW).

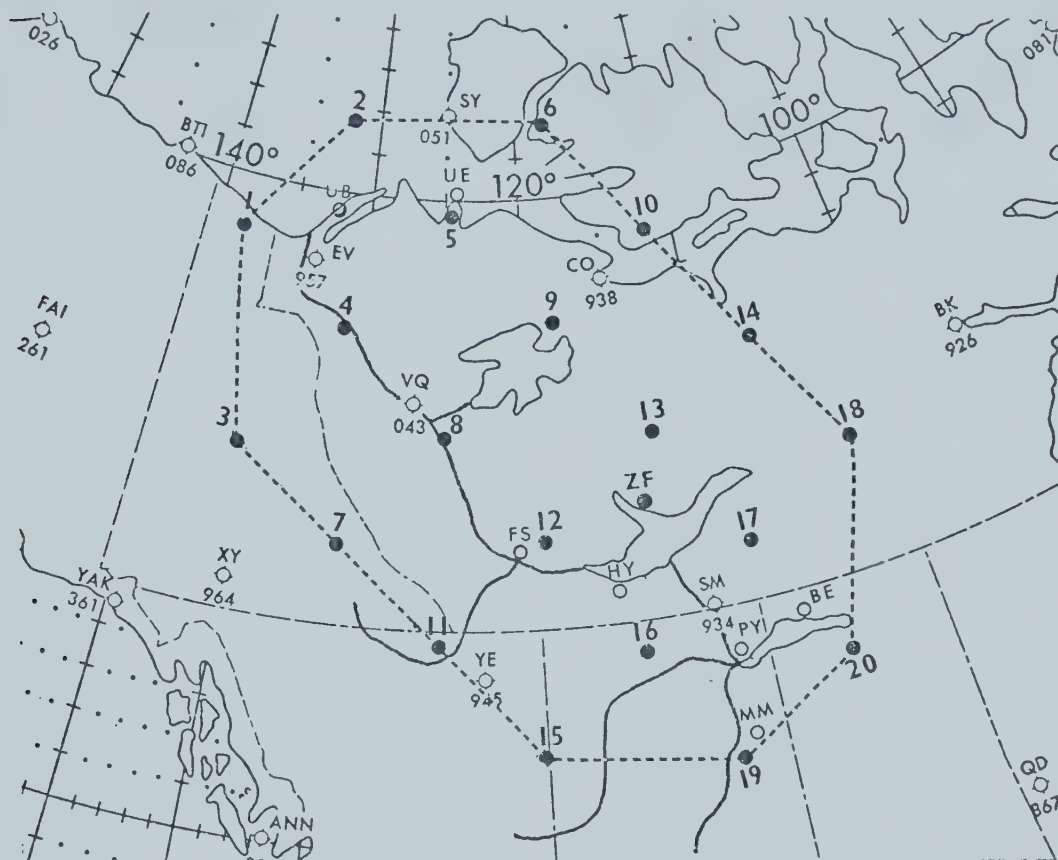


TABLE 8. GRID POINT PRESSURE VALUES AND STANDARD
 DEVIATIONS OF THE MEAN PRESSURE GRADIENT

MAP TYPE	KEY MAP DATE	S.D. OF MEAN GRADIENT	GRID POINT PRESSURES ON KEY MAP (MSL PRESSURE - 1000 MB)											
1	12Z, 25 FEB 55	1.89	39	38	41	43	38	30	36	40	33	26		
2	12Z, 13 DEC 62	1.79	32	35	29	21	30	30	24	17	26	20		
3	12Z, 22 DEC 62	2.09	4	16	-1	6	18	28	2	11	22	28		
4	12Z, 24 JAN 57	1.93	8	15	25	29	13	18	27	29	19	28		
5	12Z, 22 DEC 59	1.68	42	37	41	42	32	16	44	42	29	11		
6	12Z, 16 DEC 62	1.49	43	42	29	12	43	42	32	16	40	33		
7	12Z, 3 DEC 60	1.48	23	15	50	33	20	15	49	36	27	20		
			48	40	34	25	44	38	34	27	38	34		
			-2	-2	3	0	-1	6	8	5	5	8		
			13	12	14	17	18	18	22	25	24	28		
			14	22	2	13	21	24	3	12	19	23		
			5	7	13	19	3	1	5	14	-1	0		
			27	27	14	24	23	18	7	20	19	13		
			1	14	14	9	1	9	10	6	7	9		

TABLE 8. GRID POINT PRESSURE VALUES AND STANDARD DEVIATIONS OF THE MEAN PRESSURE GRADIENT (CONTINUED)

MAP TYPE	KEY MAP DATE	S.D. OF MEAN GRADIENT	GRID POINT PRESSURES ON KEY MAP (MSL PRESSURE - 1000 MB)											
8	12Z, 21 DEC 63	1.41	14	22	21	22	27	30	26	28	31	31		
9	12Z, 19 DEC 56	1.19	28	32	34	31	30	34	35	31	34	34		
10	12Z, 16 FEB 63	1.16	15	14	6	16	17	11	7	17	18	15		
11	12Z, 30 DEC 57	1.53	7	15	17	17	7	15	17	17	13	17		
12	12Z, 9 DEC 55	1.64	32	34	25	36	34	27	24	35	31	21		
13	12Z, 10 FEB 56	1.46	27	33	28	21	24	27	25	22	24	23		
14	12Z, 27 DEC 59	1.26	21	20	19	22	20	21	20	22	23	26		
15	12Z, 4 DEC 67	1.78	20	21	25	31	21	20	27	33	24	29		
16	12Z, 5 DEC 66	1.32	13	16	0	8	10	15	0	7	7	12		
17	12Z, 19 DEC 61	1.41	2	3	4	13	5	4	10	20	10	18		
18	12Z, 7 FEB 68	1.17	31	24	30	31	24	17	21	27	25	21		
19	12Z, 16 FEB 60	0.97	14	20	22	23	11	16	21	25	9	18		
20	12Z, 19 DEC 60	1.32	18	22	0	13	18	13	4	13	17	15		
21	12Z, 10 FEB 57	1.07	10	15	19	19	18	20	24	27	28	30		
22	12Z, 3 DEC 70	0.82	7	0	-5	4	3	9	-3	4	5	14		
23	12Z, 13 JAN 55	0.78	-3	0	3	15	-6	-5	3	17	-6	3		
24	12Z, 19 FEB 68	0.74	20	11	28	23	13	1	23	24	14	5		
U		1.47	14	20	15	11	7	13	16	16	2	12		

APPENDIX 2

CHRONOLOGICAL LISTING OF THE MAP TYPES ASSIGNED TO EACH MAP

The map types that were assigned to each of the 3814 surface maps, using the correlation coefficient threshold of $r = 0.8$, are listed in chronological order. The first eight-digit number in a group contains the year, month, day and hour (GMT) of the map. The second number is the highest correlation coefficient resulting from the correlation between the map and the 24 map types. This is followed by the designator of the corresponding type which has appended to it a pressure gradient classification, which is either strong (S), medium (M) or weak (W). The second highest correlation coefficient follows next, except for uncorrelated maps (Type U) where asterisks (*) replace the correlation coefficient. If the second highest correlation coefficient is greater than or equal to the threshold value, then the designator of the corresponding type is listed. If this secondary type is listed, and its corresponding correlation coefficient is within 0.05 of the highest correlation coefficient, the type is marked with an asterisk (*).

46010112	0.943	6M	0.681	46010212	0.752	US	*****	10	46010312	0.922	12M	0.813	7*	46010412	0.933	6M	0.704	19
46010512	0.946	6M	0.773	46010612	0.712	UM	*****	6	46010712	0.850	6M	0.774		46010812	0.558	UM	*****	10
46010912	0.851	1M	0.828	46011012	0.908	1M	0.793		46011112	0.911	3M	0.736		46011212	0.733	UM	*****	5
46011312	0.617	UM	*****	46011412	0.945	8M	0.744	8	46011512	0.964	2M	0.811	23	46011612	0.908	18M	0.829	18
46011712	0.839	6M	0.702	46011812	0.747	UM	*****	8	46011912	0.687	UM	*****	1	46012012	0.848	5M	0.867	2
46012112	0.519	UM	*****	46012212	0.743	1M	0.752	8*	46012312	0.908	3M	0.747		46012412	0.972	1M	0.832	18
46012512	0.979	3M	0.605	46012612	0.967	1M	0.569	18*	46012712	0.854	7M	0.864	5	46012812	0.801	9M	0.653	
46012912	0.907	8M	0.645	46013012	0.956	2M	0.910	9	46013112	0.813	11M	0.774	19	46020112	0.803	21M	0.787	6
46020212	0.686	1M	*****	46020312	0.732	UM	*****	10	46020412	0.769	UM	*****	19	46020512	0.785	UM	*****	6
46020612	0.586	6M	0.616	46020712	0.808	6M	0.749		46020812	0.835	9M	0.737	2	46020912	0.821	18S	0.732	
46021012	0.718	UM	*****	46021112	0.810	8M	0.715		46021212	0.873	2M	0.853	2*	46021312	0.875	6M	0.730	
46021412	0.979	2S	0.799	46021512	0.963	19M	0.601	15	46021612	0.937	6M	0.775		46021712	0.899	2M	0.768	
46021612	0.655	1M	*****	46021912	0.960	3M	0.601	7*	46022012	0.925	9M	0.647		46022112	0.875	6M	0.730	
46022212	0.831	6M	0.749	46022312	0.713	UM	*****	10	46022412	0.903	10M	0.647		46022512	0.831	18M	0.729	24
46022612	0.918	2M	0.795	46022712	0.781	UM	*****	5	46022812	0.802	9M	0.630		46120112	0.718	UM	0.788	
46120212	0.777	UM	*****	46120312	0.825	UM	*****	24	46120412	0.802	9M	0.630		46120512	0.911	6M	0.788	
46120612	0.931	7M	0.793	46120712	0.912	7M	0.707		46120812	0.805	7S	0.788		46120912	0.907	1M	0.662	
46121012	0.911	3M	0.770	46121112	0.877	1M	0.727		46121212	0.887	1M	0.690	21	46121312	0.906	1M	0.720	12
46121412	0.863	10M	0.857	46121512	0.918	1M	0.809	18*	46121612	0.706	UM	*****	3	46121712	0.946	8S	0.809	
46121812	0.822	5M	0.676	46121912	0.575	UM	*****	12	46122012	0.764	US	*****	6*	46122112	0.823	22M	0.598	18
46122012	0.659	UM	*****	46122312	0.778	UM	*****	11	46122412	0.818	10M	0.817	19	46122512	0.736	UM	*****	
46122612	0.620	UM	*****	46122712	0.755	UM	*****	12	46122812	0.824	8M	0.797		46122912	0.840	20M	0.565	
46123012	0.931	1M	0.720	46123112	0.620	7S	*****	22	46123212	0.834	8M	0.790		46123312	0.888	5M	0.718	
46123412	0.861	3M	0.670	46123512	0.633	UM	*****	1	46123612	0.934	4M	0.740		46123712	0.821	4M	0.420	1
46123712	0.861	4M	0.718	46123812	0.637	UM	*****	9	46123912	0.812	1M	0.790		46124012	0.821	4M	0.420	2
46123912	0.838	4M	0.638	46124012	0.935	16M	0.715		46124112	0.732	UM	*****	11	46124212	0.788	UM	*****	6
46124112	0.802	7M	0.789	46124212	0.908	13M	0.753	3*	46124312	0.897	9M	0.594		46124412	0.868	6S	0.812	2
46124312	0.869	1M	0.737	46124412	0.911	10M	0.807		46124512	0.743	UM	*****	10	46124612	0.924	9M	0.798	3*
46124512	0.808	5M	0.808	46124612	0.892	7S	0.781		46124712	0.894	7M	0.896	11*	46124812	0.808	13M	0.808	3*
46124712	0.676	16M	0.676	46124812	0.813	3M	0.777		46124912	0.887	16M	0.852	24*	46125012	0.797	UM	*****	24
46124912	0.830	23M	0.712	46125012	0.737	UM	*****	10	46125112	0.812	19M	0.736		46125212	0.849	1M	0.829	4*
46200412	0.795	US	*****	46200512	0.817	18M	0.767		46200612	0.690	US	*****	3	46200712	0.770	3M	*****	2
46200812	0.905	5M	0.738	46200912	0.715	10S	0.657	3*	46201012	0.897	10M	0.847	3*	46201112	0.871	10M	0.787	22
46201212	0.823	9S	0.736	46201312	0.768	UM	*****	10	46201412	0.835	2M	0.786		46201512	0.629	UM	*****	14
46201512	0.955	1M	0.779	46201612	0.860	20S	0.613		46201712	0.933	20M	0.672		46201812	0.741	UM	*****	
46202012	0.806	18M	0.677	46202112	0.941	6M	0.718	7	46202212	0.931	2S	0.815	14	46202312	0.975	2S	0.750	4
46202212	0.863	6M	0.825	46202312	0.930	8M	0.834		46202412	0.641	UM	*****	6	46202512	0.872	6M	0.748	
46202412	0.901	5M	0.799	46202512	0.694	UM	*****	2	46202612	0.855	5M	0.848	2*	46202712	0.809	2M	0.742	
46202812	0.863	6M	0.825	46202912	0.694	UM	*****	15*	46203012	0.914	2M	0.749		46203112	0.754	UM	*****	19
46203012	0.863	6M	0.825	46203112	0.656	6M	0.839	17*	46203212	0.733	UM	*****	19	46203312	0.754	UM	*****	21
46203212	0.847	2M	0.775	46203312	0.532	6M	0.733		46203412	0.809	19M	0.703		46203512	0.742	UM	*****	14
46203412	0.847	2M	0.775	46203512	0.331	2S	0.789		46203612	0.893	12S	0.832	7	46203712	0.742	UM	*****	21
46203612	0.915	2M	0.758	46203712	0.370	2M	0.761		46203812	0.790	UM	*****	12	46203912	0.837	14M	0.751	
46203812	0.933	UM	*****	46203912	0.821	8M	0.530		46204012	0.721	UM	*****	15	46204112	0.670	UM	*****	21
46204012	0.810	12S	0.774	46204112	0.907	2M	0.733		46204212	0.814	8M	0.862	7*	46204312	0.977	2S	0.741	18
46204212	0.810	12S	0.774	46204312	0.847	6S	0.555		46204412	0.640	UM	*****	21	46204512	0.882	UM	*****	4*
46204412	0.716	3M	*****	46204512	0.775	UM	*****	16	46204612	0.847	20M	0.753		46204712	0.880	14M	0.707	
46204612	0.658	UM	*****	46204712	0.928	7S	0.826	18	46204812	0.862	10M	0.845	3*	46204912	0.843	1M	0.821	
46204812	0.745	UM	*****	46204912	0.848	10M	0.810		46205012	0.637	UM	*****	2	46205112	0.943	5M	0.721	
46205012	0.745	UM	*****	46205112	0.731	2M	0.810		46205212	0.732	UM	*****	15	46205312	0.748	UM	*****	2
46205212	0.915	11S	0.837	46205312	0.756	UM	*****	8	46205412	0.793	UM	*****	1	46205512	0.793	US	*****	22
46205412	0.716	3M	*****	46205512	0.959	5M	0.897	2	46205612	0.776	US	*****	12	46205712	0.705	UM	*****	9
46205612	0.802	1M	0.768	46205712	0.955	13M	0.623		46205812	0.766	US	*****	3	46205912	0.541	UM	*****	2
46205812	0.897	4S	0.750	46205912	0.940	1M	0.735	18	46206012	0.801	4M	0.839	4*	46206112	0.832	4M	0.761	1*
46206012	0.897	4S	0.750	46206112	0.940	1M	0.735		46206212	0.882	1M	0.769		46206312	0.863	3S	0.817	4*
46206212	0.897	4S	0.750	46206312	0.940	1M	0.735		46206412	0.882	1M	0.769		46206512	0.892	1S	0.855	
46206412	0.897	4S	0.750	46206512	0.940	1M	0.735		46206612	0.765	UM	*****	22	46206712	0.864	4M	0.793	
46206612	0.897	4S	0.750	46206712	0.940	1M	0.735		46206812	0.816	5M	0.815	8*	46206912	0.942	21M	0.782	
46206812	0.897	4S	0.750	46206912	0.940	1M	0.735		46207012	0.889	9M	0.790		46207112	0.936	6M	0.742	
46207012	0.897	4S	0.750	46207112	0.940	1M	0.735		46207212	0.889	9M	0.790		46207312	0.936	6M	0.742	

48022612	0.815	13M	0.810	6*	48022712	0.799	7M	***	24	48022812	0.604	UM	***	19	48022912	0.952	3M	0.637
48120112	0.869	12M	0.784		48120212	0.846	7S	0.799		48120312	0.910	1M	0.799		48120412	0.552	UM	***
48120512	0.920	13M	0.787		48120612	0.909	7M	0.818	11	48120712	0.794	UM	***	5	48120812	0.542	UM	***
48120912	0.681	UM	***	21	48121012	0.787	UM	***	10	48121112	0.719	UM	***	17	48121212	0.861	1M	0.816
48121312	0.777	US	***	1	48121412	0.793	US	***	12	48121512	0.825	5M	0.655		48121612	0.734	UM	***
48121712	0.698	UM	***	1	48121812	0.895	11M	0.838	12*	48121912	0.739	UM	***	5	48122012	0.881	6M	0.792
48122112	0.801	7M	0.779		48122212	0.798	UM	***	2	48122312	0.932	2S	0.756		48122412	0.805	15S	0.798
48122512	0.762	US	***	2	48122612	0.919	2M	0.774		48122712	0.723	UM	***	1	48122812	0.754	UM	***
48122912	0.930	12M	0.663		48123012	0.893	10S	0.798		48123112	0.829	9S	0.767		48123212	0.894	19S	0.787
49010212	0.831	18M	0.756		49010312	0.957	2S	0.846	2	49010412	0.751	US	***	12	49010512	0.750	US	***
49010612	0.894	1S	0.587		49010712	0.924	1S	0.685		49010812	0.666	US	***	1	49010912	0.896	5S	0.810
49011012	0.943	5S	0.677		49011112	0.728	UM	***	4	49011212	0.832	6M	0.802	6*	49011312	0.960	6M	0.681
49011412	0.897	6M	0.682	17*	49011512	0.734	UM	***	10	49011612	0.881	2S	0.812	20	49011712	0.851	19S	0.765
49011812	0.872	3M	0.687		49011912	0.848	5M	0.741		49012012	0.801	8M	0.728		49012112	0.832	1M	0.755
49012212	0.746	US	***	1	49012312	0.810	5M	0.774		49012412	0.821	5M	0.748		49012512	0.654	UM	***
49012612	0.838	3M	0.930	3*	49012712	0.906	3M	0.869	1*	49012812	0.729	UM	***	2	49012912	0.655	US	***
49012912	0.750	US	***	3	49013012	0.724	UM	***	22	49020112	0.898	4M	0.730		49020212	0.874	1M	0.645
49020312	0.868	1M	0.842	22*	49020412	0.735	UM	***	4	49020512	0.756	UM	***	14	49020612	0.908	7M	0.715
49020712	0.801	2M	0.776		49020812	0.806	10M	0.761		49020912	0.595	UM	***	4	49021012	0.913	13S	0.726
49021112	0.813	4M	0.575		49021212	0.867	5M	0.739		49021312	0.741	UM	***	10	49021412	0.751	US	***
49021512	0.714	UM	***	18	49021612	0.917	7S	0.788		49021712	0.893	1M	0.748		49021812	0.913	3M	0.734
49021912	0.914	3M	0.858	1	49022012	0.727	UM	***	22	49022112	0.967	3M	0.690		49022212	0.829	1M	0.791
49022312	0.763	UM	***	10	49022412	0.739	UM	***	18	49022512	0.783	UM	***	6	49022612	0.872	2M	0.764
49022712	0.902	12M	0.805	13	49022812	0.872	6M	0.704		49120112	0.905	11M	0.747		49120212	0.712	UM	***
49120312	0.683	UM	***	21	49120412	0.596	UM	***	1	49120512	0.933	2S	0.768		49120612	0.946	5M	0.727
49120712	0.879	5M	0.716		49120812	0.920	14S	0.742		49120912	0.818	1S	0.759		49121012	0.918	1M	0.745
49121112	0.871	8M	0.508		49121212	0.731	UM	***	2	49121312	0.694	UM	***	8	49121412	0.866	16M	0.623
49121512	0.815	3M	0.732		49121612	0.804	3M	0.786		49121712	0.961	3M	0.809	3	49121812	0.895	3M	0.806
49121912	0.807	5M	0.591		49122012	0.970	17M	0.737		49122112	0.931	1M	0.726		49122212	0.649	UM	***
49122312	0.829	3M	0.817	1*	49122412	0.728	US	***	16	49122512	0.776	UM	***	11	49122612	0.840	4M	0.834
49122712	0.841	3M	0.755		49122812	0.952	4M	0.781	4*	49122912	0.712	UM	***	8	49123012	0.691	US	***
49123112	0.808	1M	0.635		50010112	0.670	4M	0.834		50010212	0.800	5M	0.728		50010312	0.305	UM	***
50010412	0.965	4M	0.616		50010512	0.810	9S	0.755		50010612	0.750	UM	***	22	50010712	0.802	4M	0.794
50010812	0.828	3M	0.797	4	50010912	0.867	3M	0.806	3	50011012	0.956	4M	0.741		50011112	0.817	1M	0.729
50011212	0.755	UM	***		50011312	0.929	4M	0.693		50011412	0.806	4M	0.741		50011512	0.867	1M	0.585
50011612	0.661	1M	0.821	4*	50011712	0.627	4M	0.735		50011812	0.914	3M	0.700		50011912	0.932	3M	0.674
50012012	0.845	3M	0.664		50012112	0.934	1M	0.815	18	50012212	0.894	4M	0.827	8	50012312	0.827	4M	0.787
50012412	0.777	UM	***	12	50012512	0.628	UM	***	16	50012612	0.874	3M	0.668		50012712	0.809	1M	0.589
50012812	0.817	1M	0.797		50012912	0.885	1M	0.816		50013012	0.874	3M	0.668		50013112	0.859	1S	0.726
50013212	0.907	4M	0.838	4	50020112	0.582	UM	***	3	50020312	0.886	1M	0.826	6	50020412	0.798	UM	***
50013512	0.837	3M	0.631		50020612	0.859	2M	0.804	23	50020712	0.576	UM	***	11	50020812	0.861	16M	0.766
50013812	0.770	UM	***	24	50021012	0.668	UM	***	16	50021112	0.795	US	***	5	50021212	0.728	UM	***
50014112	0.887	21S	0.799		50021412	0.588	7M	0.757		50021512	0.824	13M	0.823	17*	50021612	0.909	1M	0.684
50021712	0.863	1M	0.735		50021912	0.677	UM	***	2	50021912	0.870	11S	0.857	7*	50022012	0.946	2M	0.823
50022112	0.869	11M	0.738		50022312	0.677	UM	0.817	10	50022312	0.823	12M	0.783		50022412	0.758	UM	***
50022512	0.798	UM	***	5	50022612	0.839	15M	0.801	16*	50022712	0.903	1M	0.848	18	50022812	0.659	20M	0.643
50022912	0.909	8M	0.741		50120112	0.530	UM	***	21	50120312	0.756	UM	***	21	50120412	0.700	UM	***
50023512	0.893	5M	0.727		50120612	0.904	12S	0.697		50120712	0.784	UM	***	6	50120812	0.882	19M	0.738
50023912	0.901	8M	0.798		50121012	0.562	UM	***	12	50121112	0.737	US	***	1	50121212	0.790	UM	***
50024112	0.770	US	***	2	50121412	0.884	8M	0.835	12*	50121512	0.857	10M	0.653		50121612	0.701	UM	***
50024712	0.909	3M	0.809		50121812	0.827	10M	0.711		50121912	0.895	11M	0.878	3*	50122012	0.775	UM	***
50025112	0.699	UM	***	5	50122212	0.943	6S	0.800		50122312	0.833	18M	0.815	7*	50122412	0.685	2M	0.795
50025512	0.924	2M	0.824		50122612	0.747	UM	***	21	50122712	0.886	18M	0.675		50122812	0.657	UM	***
50025912	0.595	UM	***	6	50123012	0.911	6M	0.737		50123112	0.840	18M	0.615		50123212	0.827	19M	0.685
50026312	0.595	UM	***	1	50123312	0.858	20M	0.720		50123412	0.848	17M	0.739		50123512	0.820	4M	0.711
50026712	0.835	12M	0.770		50123612	0.835	14M	0.782		50123712	0.603	UM	***	15	50123812	0.429	UM	***
50027112	0.794	UM	***		50123912	0.890	7M	0.746		50124012	0.587	UM	***	9	50124112	0.716	US	***
50027512	0.866	1M	0.796		50124212	0.825	10M	0.757		50124312	0.859	6M	0.783		50124412	0.879	6M	0.961
50027912	0.809	6M	0.796		50124512	0.505	UM	***	6	50124612	0.847	14M	0.802	13*	50124712	0.854	7M	0.770
50028312	0.850	19M	0.817	15*	50124812	0.828	1M	0.733		50124912	0.733	UM	***	22	50125012	0.741	UM	***

51012612	0.871	4M	0.817	4	51012712	0.910	4M	0.582	1	51012812	0.892	4M	0.783	4*	51012912	0.837	1S	0.935	4*
51013012	0.879	3S	0.781		51013112	0.773	US	0.719		51020112	0.891	1S	0.855	4	51020212	0.767	UM	0.855	4
51020312	0.872	10M	0.817	3	51020412	0.845	17*	0.719		51020512	0.751	US	0.693	1	51020612	0.897	3M	0.730	
51020712	0.810	3M	0.690		51020812	0.812	9M	0.737		51020912	0.902	13M	0.693		51021012	0.919	3M	0.826	1
51021112	0.852	4M	0.848	4*	51021212	0.895	4M	0.805	8	51021312	0.793	US	0.693	12	51021412	0.759	UM	0.886	8
51021512	0.772	UM	0.772	11	51021612	0.803	15M	0.742		51021712	0.757	US	0.597	16	51021812	0.760	UM	0.886	5
51021912	0.884	21M	0.840	20*	51022012	0.869	1M	0.804	18	51022112	0.861	8M	0.597	10	51022212	0.742	UM	0.760	13
51022312	0.743	UM	0.770	7	51022412	0.893	7M	0.770		51022512	0.689	US	0.782	15	51022612	0.870	US	0.760	15
51022712	0.910	5M	0.870	13*	51022812	0.868	22M	0.673		51022912	0.841	15M	0.782		51023012	0.796	UM	0.760	
51023312	0.802	12M	0.568		51023412	0.930	19M	0.743		51023512	0.851	2M	0.837	14*	51023612	0.901	2M	0.785	
51023712	0.811	11M	0.666		51023812	0.834	14M	0.693		51023912	0.813	7M	0.803	3*	51024012	0.807	20M	0.765	
51024112	0.714	5M	0.666	6	51024212	0.829	1M	0.703		51024312	0.927	1S	0.822	4	51024412	0.937	3S	0.750	
51024512	0.810	4M	0.721		51024612	0.906	1M	0.519		51024712	0.891	4M	0.702		51024812	0.931	4M	0.686	
51024912	0.793	US	0.770	12	51025012	0.533	UM	0.666	12	51025112	0.955	UM	0.782	24	51025212	0.814	4M	0.791	
51025312	0.765	UM	0.789	1	51025412	0.760	UM	0.666	3	51025512	0.936	1M	0.781		51025612	0.914	4S	0.627	
51025712	0.714	4S	0.789		51025812	0.711	US	0.666	3	51025912	0.896	1M	0.667		51026012	0.821	5M	0.727	
51026112	0.928	5M	0.829	2	51026212	0.956	5M	0.646	22	51026312	0.820	10M	0.727	22	51026412	0.902	13S	0.651	1
51026512	0.954	5M	0.852	2	51026612	0.735	UM	0.666	11*	51026712	0.832	13M	0.665		51026812	0.718	UM	0.735	24
51026912	0.821	3M	0.790		51027012	0.841	9M	0.643		51027112	0.832	4M	0.776	12	51027212	0.795	US	0.735	12
51027312	0.849	5M	0.842	2	51027412	0.846	7S	0.752	11*	51027512	0.883	7M	0.853	17*	51027612	0.998	7M	0.810	17
51027712	0.862	UM	0.833	12	51027812	0.832	7M	0.836	18*	51027912	0.893	1M	0.800		51028012	0.907	1M	0.735	
51027912	0.833	7M	0.833	3*	51028012	0.841	23M	0.829	17*	51028112	0.864	3M	0.713		51028212	0.803	4M	0.623	
51028312	0.838	1S	0.749	9*	51028412	0.838	7M	0.790		51028512	0.912	7M	0.825	18	51028612	0.810	10M	0.618	
51028712	0.815	8M	0.801		51028812	0.760	UM	0.666	5	51028912	0.697	UM	0.786	10	51029012	0.863	9M	0.707	
51028912	0.891	9M	0.713		51029012	0.913	6M	0.830	17	51029112	0.847	2M	0.746		51029212	0.805	6M	0.795	
51029312	0.838	1M	0.677		51029412	0.744	UM	0.666	6	51029512	0.899	13M	0.746		51029612	0.906	13M	0.797	10
51029512	0.818	2M	0.749		51029612	0.792	UM	0.666	20	51029712	0.947	21M	0.761	20	51029812	0.757	UM	0.797	19
51029712	0.687	7M	0.777	5	51029812	0.804	12M	0.795		51029912	0.791	UM	0.781		51030012	0.721	UM	0.797	
51029912	0.845	7M	0.729		51030012	0.782	UM	0.666	10	51030112	0.840	11M	0.786		51030212	0.966	2M	0.729	
51030112	0.812	12M	0.618		51030212	0.866	6M	0.705		51030312	0.802	6M	0.819	13	51030412	0.845	2M	0.844	20*
51030312	0.803	6M	0.771	5	51030412	0.785	UM	0.666	10	51030512	0.970	2M	0.819	13	51030612	0.898	6M	0.792	
51030512	0.785	UM	0.681		51030612	0.812	15M	0.687		51030712	0.823	18M	0.819	5*	51030812	0.843	1M	0.813	8*
51030712	0.838	6M	0.681		51030812	0.917	8M	0.738		51030912	0.833	UM	0.666	13	51031012	0.844	1M	0.824	4*
51030912	0.931	5M	0.718		51031012	0.810	14S	0.602	12*	51031112	0.566	UM	0.666	8	51031212	0.833	10M	0.779	
51031112	0.920	20M	0.730		51031212	0.696	UM	0.666	2	51031312	0.394	UM	0.666	20	51031412	0.826	2M	0.702	
51031312	0.657	UM	0.666	10	51031412	0.647	UM	0.666	18	51031512	0.768	UM	0.666	14	51031612	0.882	18M	0.808	14
51031512	0.872	11M	0.854	9*	51031612	0.919	2M	0.805	14	51031712	0.877	6M	0.742	2	51031812	0.824	22M	0.621	5
51031712	0.793	UM	0.767	2	51031812	0.815	16M	0.638		51031912	0.944	18M	0.809	5*	51032012	0.766	UM	0.777	
51031912	0.583	UM	0.666	16	51032012	0.935	1M	0.740		51032112	0.930	1M	0.785		51032212	0.812	16M	0.727	
51032112	0.899	3M	0.873	1*	51032212	0.920	1M	0.757		51032312	0.892	3M	0.666	3*	51032412	0.829	16S	0.727	
51032312	0.669	UM	0.730	8	51032412	0.894	17S	0.623	1	51032512	0.831	17M	0.933	4*	51032612	0.845	18M	0.843	7*
51032512	0.900	2M	0.790		51032612	0.849	9M	0.543		51032712	0.788	UM	0.666	7	51032812	0.823	1M	0.797	
51032712	0.855	13S	0.835	6*	51032812	0.930	2M	0.800	14	51032912	0.811	13M	0.797		51033012	0.844	3M	0.656	7*
51032912	0.917	1M	0.764		51033012	0.971	1S	0.753		51033112	0.854	3M	0.797		51033212	0.856	15M	0.826	
51033112	0.831	15M	0.789		51033212	0.922	1M	0.781		51033312	0.757	UM	0.666	10	51033412	0.844	13M	0.664	
51033312	0.831	15M	0.789		51033412	0.901	11M	0.663	7*	51033512	0.780	UM	0.666	23	51033612	0.863	14S	0.937	12*
51033512	0.701	UM	0.666	11	51033612	0.960	21M	0.813	10*	51033712	0.849	18M	0.789		51033812	0.907	18M	0.794	
51033712	0.645	US	0.666	4	51033812	0.792	UM	0.666	4	51033912	0.510	UM	0.666	14	51034012	0.838	18S	0.835	5*
51033912	0.975	2S	0.724		51034012	0.952	2S	0.763		51034112	0.885	2M	0.703		51034212	0.731	UM	0.666	4
51034112	0.913	1M	0.661	2	51034212	0.893	8M	0.601	12	51034312	0.966	5M	0.670	20	51034412	0.838	19M	0.664	
51034312	0.975	19M	0.808	15	51034412	0.542	UM	0.666	24	51034512	0.904	17M	0.856	5*	51034612	0.750	2M	0.781	
51034512	0.975	19M	0.808	15	51034612	0.843	15M	0.744		51034712	0.859	16M	0.856	5*	51034812	0.857	2M	0.792	
51034712	0.739	UM	0.748		51034812	0.815	19M	0.400	5*	51034912	0.757	UM	0.666	7	51035012	0.802	6M	0.792	
51034912	0.890	6M	0.744		51035012	0.966	2M	0.844	20*	51035112	0.956	6M	0.837	17	51035212	0.798	UM	0.792	
51035112	0.822	21M	0.772		51035212	0.805	4M	0.579		51035312	0.823	14M	0.656		51035412	0.761	UM	0.792	
51035312	0.975	5M	0.760		51035412	0.858	6M	0.818	17*	51035512	0.869	7M	0.846	18*	51035612	0.912	8M	0.588	
51035512	0.862	5M	0.782		51035612	0.802	18M	0.605		51035712	0.890	6M	0.839	17	51035812	0.727	UM	0.792	

53122612	0.813	13M	0.800	53122712	0.905	10M	0.888	6*	53122812	0.835	7M	0.797	53122912	0.634	UM	****	4
53123012	0.719	UM	****	53123112	0.852	7M	0.848	18*	54010112	0.935	9M	0.636	54010212	0.817	7M	0.748	
54010312	0.807	7M	0.771	54010412	0.830	9M	0.644		54010512	0.717	UM	****	19	0.881	2M	0.749	
54010712	0.926	2S	0.825	54010812	0.855	5S	0.846	2*	54010912	0.893	5M	0.735	54011012	0.795	UM	****	12
54011112	0.800	US	****	54011212	0.731	US	****	18	54011312	0.839	3M	0.769	54011412	0.957	1M	0.683	
54011512	0.826	4M	0.759	54011612	0.902	1M	0.659		54011712	0.877	4S	0.832	54011812	0.889	1M	0.778	
54011912	0.874	1M	0.797	54012012	0.807	1M	0.656		54012112	0.859	4S	0.830	54012212	0.844	3S	0.795	
54012312	0.829	3M	0.782	54012412	0.929	1M	0.781		54012512	0.924	3M	0.759	54012612	0.838	1M	0.811	18*
54012712	0.759	UM	****	54012812	0.918	22M	0.588		54012912	0.880	5M	0.664	54013012	0.910	1M	0.871	9*
54013112	0.404	UM	****	54020112	0.630	UM	****	18	54020212	0.919	1US	0.868	54020312	0.897	1M	0.686	
54020412	0.844	14M	0.648	54020512	0.813	18M	0.510		54020612	0.786	US	****	54020712	0.855	3M	0.583	
54020812	0.724	UM	****	54020912	0.888	1M	0.742		54021012	0.882	1M	0.776	54021112	0.947	4S	0.783	
54021212	0.935	1S	0.790	54021312	0.863	3M	0.769		54021412	0.820	4M	0.816	54021512	0.876	17M	0.758	
54021612	0.918	17M	0.633	54021712	0.685	UM	****	10	54021812	0.787	US	****	54021912	0.768	UM	****	24
54022012	0.716	UM	****	54022112	0.909	5M	0.829	2	54022212	0.894	5M	0.696	54022312	0.641	UM	****	20
54022412	0.667	UM	****	54022512	0.721	US	****	6	54022612	0.910	1M	0.678	54022712	0.719	UM	****	1
54022812	0.855	16M	0.767	54120112	0.720	US	****	2	54120212	0.812	4M	0.746	54120312	0.857	7M	0.925	18*
54120412	0.855	21M	0.840	54120512	0.589	UM	****	23	54120612	0.760	UM	****	54120712	0.624	UM	****	22
54120812	0.837	5M	0.708	54120912	0.725	UM	****	16	54121012	0.790	UM	****	54121112	0.874	2M	0.869	13*
54121212	0.650	UM	****	54121312	0.889	13M	0.672		54121412	0.853	9M	0.793	54121512	0.841	19M	0.658	
54121612	0.771	UM	****	54121712	0.825	UM	0.651		54121812	0.816	3M	0.612	54121912	0.791	UM	****	23
54122012	0.822	2M	0.789	54122112	0.654	UM	0.661	14	54122212	0.931	6M	0.835	54122312	0.842	13M	0.803	6*
54122412	0.855	13M	0.695	54122512	0.871	7M	0.803	3	54122612	0.848	9M	0.624	54122712	0.916	13M	0.755	
54122812	0.873	16S	0.668	54122912	0.954	4S	0.773		54123012	0.799	UM	****	54123112	0.657	16M	0.724	
54123212	0.900	4M	0.612	55010212	0.870	5M	0.827	2*	55010312	0.790	US	****	55010412	0.792	UM	****	3
55010112	0.921	2M	0.757	55010512	0.836	11M	0.820	7*	55010712	0.711	UM	****	55010812	0.781	UM	****	3
55010912	0.755	UM	****	55011012	0.808	8M	0.772		55011112	0.906	5M	0.843	55011212	0.892	5M	0.877	13*
55011312	1.000	23M	0.722	55011412	0.670	UM	****	14	55011512	0.864	6M	0.773	55011612	0.982	18M	0.842	5*
55011712	0.828	2M	0.802	55011812	0.701	2M	0.833	2*	55011912	0.892	5M	0.924	55012012	0.267	UM	****	20
55012112	0.782	UM	****	55012212	0.871	2M	0.768		55012312	0.747	UM	****	55012412	0.912	18M	0.695	
55012512	0.912	2M	0.813	55012612	0.547	UM	****	12	55012712	0.817	8M	0.591	55012812	0.788	UM	****	11
55012912	0.870	7M	0.650	55013012	0.946	7M	0.855	18	55013112	0.856	9M	0.853	55020112	0.797	UM	****	16
55020212	0.831	2M	0.791	55020312	0.730	UM	****	20	55020412	0.877	6M	0.812	55020512	0.883	6M	0.774	
55020612	0.831	9S	0.812	55020712	0.865	7S	0.843	5*	55020812	0.849	7M	0.819	55020912	0.814	17M	0.641	
55021012	0.681	UM	****	55021112	0.871	2S	0.830	9*	55021212	0.872	12M	0.815	55021312	0.932	7M	0.704	
55021412	0.935	11M	0.737	55021512	0.790	UM	****	5	55021612	0.825	7M	0.792	55021712	0.833	1M	0.636	
55021812	0.815	5M	0.795	55021912	0.555	UM	****	22	55022012	0.843	7M	0.797	55022112	0.879	13S	0.746	
55022212	0.909	3M	0.872	55022312	0.844	17M	0.737		55022412	0.712	US	****	55022512	1.000	1M	0.781	
55022612	0.909	4M	0.649	55022712	0.776	UM	****	20	55022812	0.823	7M	0.819	55022912	0.847	6M	0.793	
55120112	0.839	2M	0.736	55120200	0.820	2M	0.811	13*	55120312	0.836	5M	0.784	55120412	0.600	UM	****	9
55120312	0.903	7M	0.774	55120400	0.883	10M	0.871	6*	55120512	0.695	UM	****	55120600	0.828	17M	0.528	
55120512	0.948	17M	0.656	55120600	0.754	UM	****	6	55120612	0.943	7S	0.781	55120700	0.928	7M	0.382	18*
55120712	0.783	UM	****	55120800	0.868	9M	0.854	7*	55120812	0.917	2S	0.835	55120900	0.950	12M	0.786	
55120912	1.000	12M	0.717	55121000	0.889	12M	0.760		55121012	0.739	UM	****	55121100	0.775	UM	****	6
55121112	0.894	1M	0.743	55121200	0.854	13M	0.765		55121212	0.761	US	****	55121300	0.612	US	****	22
55121312	0.810	4M	0.497	55121400	0.931	4M	0.544		55121412	0.916	4M	0.659	55121500	0.965	4M	0.582	
55121512	0.846	4M	0.531	55121600	0.674	US	****	3	55121612	0.899	1M	0.671	55121700	0.940	1M	0.789	
55121712	0.877	1M	0.797	55121800	0.813	3M	0.807	3*	55121812	0.770	US	****	55121900	0.851	1M	0.799	
55121912	0.837	3M	0.749	55122000	0.732	UM	****	8	55122012	0.777	US	****	55122100	0.818	5M	0.593	
55122112	0.756	UM	****	55122200	0.730	UM	****	13	55122212	0.695	UM	****	55122300	0.650	UM	****	24
55122312	0.623	UM	****	55122400	0.904	1M	0.610		55122412	0.963	1M	0.650	55122500	0.710	UM	****	3
55122512	0.701	UM	****	55122600	0.736	US	****	12	55122612	0.810	22M	0.676	55122700	0.950	4M	0.614	
55122712	0.907	4S	0.559	55122800	0.853	5S	0.729		55122812	0.789	US	****	55122900	0.795	UM	****	8
55122912	0.769	US	****	55123000	0.506	UM	****	12	55123012	0.473	UM	****	55123100	0.644	UM	****	14
55123112	0.800	12M	0.660	56010100	0.829	7M	0.692		56010112	0.876	7S	0.757	56010200	0.843	7S	0.795	
56010212	0.860	6M	0.824	56010300	0.774	UM	****	23	56010312	0.697	UM	****	56010400	0.790	UM	****	20
56010412	0.958	7S	0.752	56010500	0.834	7S	0.826	11	56010512	0.758	US	****	56010600	0.770	UM	****	24
56010612	0.748	US	****	56010700	0.732	US	****	13	56010712	0.749	UM	****	56010800	0.759	UM	****	12
56010812	0.816	4M	0.802	56010900	0.814	17M	0.786		56010912	0.898	16M	0.764	56011000	0.835	13M	0.811	22*
56011012	0.816	13M	0.806	56011100	0.714	UM	****	3	56011112	0.673	UM	****	56011200	0.697	UM	****	24

560111212	0.766	UM	****	1	56011300	0.748	UM	****	24	56011312	0.738	UM	****	22	56011400	0.857	4M	0.805	24
560111412	0.855	4M	0.794		56011500	0.811	17M	0.799		56011512	0.920	4M	0.770		56011600	0.811	17S	0.808	1*
560111612	0.949	17S	0.797		56011700	0.782	UM	****	9	56011712	0.890	14M	0.777		56011800	0.884	14M	0.833	20
560111812	0.875	12M	0.847	9*	56011900	0.734	12M	0.862	9	56011912	0.616	UM	****	9	56012000	0.827	9M	0.792	****
560112012	0.909	12M	0.765		56012100	0.783	12M	****	20	56012112	0.679	UM	****	19	56012200	0.775	UM	****	10
560112212	0.903	2M	0.771		56012300	0.857	12S	0.864	7*	56012312	0.905	12M	0.796		56012400	0.884	12M	0.768	
560112412	0.768	UM	****	16	56012500	0.865	11M	0.764		56012512	0.862	13M	0.741		56012600	0.827	19M	0.825	5*
560112612	0.835	6M	0.852	17*	56012700	0.790	UM	****	17	56012712	0.596	UM	****	24	56012800	0.768	UM	****	24
560112812	0.832	4M	0.681		56012900	0.868	4M	0.645		56012912	0.975	4M	0.662		56013000	0.921	4M	0.614	
560113012	0.959	4M	0.719		56013100	0.844	4M	0.804	8*	56013112	0.816	4M	0.800		56020100	0.795	UM	****	1
56020112	0.757	UM	****	4	56020200	0.844	17M	0.668		56020212	0.765	UM	****	8	56020300	0.847	3M	0.525	
56020312	0.869	3M	0.784		56020400	0.938	1M	0.761		56020412	0.779	UM	****	11	56020500	0.729	UM	****	10
56020512	0.786	UM	****	13	56020600	0.777	UM	****	13	56020612	0.878	22M	0.641		56020700	0.852	4M	0.829	24*
56020712	0.843	4M	0.821	8*	56020800	0.645	UM	****	19	56020812	0.744	UM	****	6	56020900	0.895	6M	0.683	
56020912	0.797	US	****	10	56021000	0.843	9S	0.822	16*	56021012	1.000	13M	0.703		56021100	0.922	13M	0.676	
56021112	0.947	16M	0.820	11*	56021200	0.873	16M	0.764		56021212	0.901	16M	0.761		56021300	0.865	16M	0.740	
56021312	0.793	UM	****	3	56021400	0.838	4M	0.852		56021412	0.983	4M	0.666		56021500	0.894	4M	0.847	8*
56021512	0.900	5M	0.782		56021600	0.854	14M	0.714	12*	56021612	0.950	12M	0.840	16	56021700	0.847	7M	0.800	
56021712	0.886	10M	0.813	6	56021800	0.818	9M	0.714		56021812	0.853	21S	0.820	6*	56021900	0.862	13S	0.817	6*
56021912	0.844	13M	0.691		56022000	0.752	UM	****	6	56022012	0.797	UM	****	11	56022100	0.829	13M	0.729	
56022112	0.675	UM	****	23	56022200	0.799	US	****	23	56022212	0.763	US	****	13	56022300	0.796	US	****	13
56022312	0.755	US	****	13	56022400	0.788	UM	****	7	56022412	0.685	UM	****	23	56022500	0.739	UM	****	3
56022512	0.723	UM	****	1	56022600	0.893	5M	0.646		56022612	0.606	UM	****	20	56022700	0.795	UM	****	3
56022712	0.357	10M	0.849	6*	56022800	0.823	10M	0.617	19*	56022812	0.799	UM	****	19	56022900	0.917	9M	0.750	
56022912	0.829	21S	0.810	23*	56023000	0.897	1M	0.681		56120112	0.864	7S	0.858	3*	56120200	0.934	1S	0.810	6
56120212	0.958	1S	0.676		56120300	0.859	3S	0.754		56120312	0.912	3M	0.804	3	56120400	0.845	4M	0.834	3*
56120412	0.776	US	****	4	56120500	0.933	4M	0.755		56120512	0.945	4M	0.744		56120600	0.846	4M	0.803	4*
56120612	0.845	3M	0.685		56120700	0.836	1M	0.801	4*	56120712	0.922	1M	0.743		56120800	0.903	1M	0.836	4
56120812	0.821	3M	0.706		56120900	0.997	3M	0.768		56120912	0.955	3M	0.651		56121000	0.708	UM	****	4
56121012	0.844	1M	0.803	22*	56121100	0.895	1M	0.832	4*	56121112	0.853	4M	0.796		56121212	0.869	4M	0.750	
56121300	0.880	22M	0.690		56121312	0.812	22M	0.667		56121400	0.770	US	****	24	56121412	0.777	UM	****	22
56121500	0.829	3M	0.787		56121512	0.820	16M	0.757		56121600	0.827	16M	0.792		56121612	0.689	4M	0.831	8
56121700	0.899	17M	0.699		56121712	0.864	21M	0.837	10*	56121800	0.835	21M	0.817	23*	56121812	0.784	UM	****	6
56121900	0.893	10M	0.697		56121912	1.000	9M	0.704		56122000	0.773	UM	****	10	56122012	0.853	9M	0.640	
56122100	0.374	9M	0.766		56122112	0.714	UM	****	24	56122200	0.803	22M	0.785		56122212	0.791	UM	****	24
56122300	0.788	UM	****	24	56122312	0.819	22S	0.767		56122400	0.690	UM	****	8	56122412	0.825	11M	0.691	21
56122500	0.862	5M	0.727		56122512	0.848	11M	0.727		56122600	0.635	UM	****	3	56122612	0.597	UM	****	21
56122700	0.815	10M	0.683		56122712	0.930	1M	0.808	18	56122800	0.615	UM	****	19	56122812	0.954	2M	0.779	
56122900	0.920	2M	0.742		56122912	0.800	11M	0.740		56123000	0.687	UM	****	15	56123012	0.736	UM	****	17
56123100	0.824	9M	0.707		56123112	0.845	12M	0.835	16*	56123112	0.876	21M	0.839	20	56123112	0.737	UM	****	6
56123212	0.641	UM	****	7	56123300	0.752	UM	****	20	56123312	0.746	UM	****	14	56123400	0.560	UM	****	14
56123412	0.822	5M	0.606		56123500	0.864	17M	0.618		56123512	0.739	UM	****	8	56123600	0.896	1S	0.716	
56123612	0.888	10S	0.867	3*	56123600	0.814	16S	0.721		56123712	0.841	16S	0.833	4*	56123800	0.913	3S	0.762	
56123812	0.914	3M	0.822	1	56123900	0.894	3S	0.785		56123912	0.855	3M	0.807	3*	56124000	0.896	1S	0.754	
56124012	0.935	1S	0.756		56124100	0.906	3S	0.730		56124112	0.731	US	****	3	56124200	0.963	4M	0.508	
56124112	0.805	5M	0.759		56124200	0.845	4M	0.730		56124312	0.792	US	****	4	56124400	0.914	1S	0.781	
56124212	0.790	US	****	4	56124300	0.943	4S	0.515		56124412	0.945	4S	0.701		56124500	0.861	3S	0.835	1*
56124412	0.908	3S	0.774		56124400	0.945	4S	0.515		56124512	0.869	4S	0.788		56124600	0.877	3S	0.805	1
56124512	0.785	3M	0.741		56124600	0.887	1M	0.716		56124712	0.744	US	****	1	56124800	0.918	4M	0.719	
56124612	0.884	3M	0.741		56124700	0.833	3M	0.739		56124812	0.931	3M	0.693		56124900	0.856	3M	0.834	3*
56124712	0.913	1M	0.781		56124800	0.934	3M	0.739		56124912	0.884	3M	0.749		56125000	0.825	4M	0.815	4*
56124812	1.000	4M	0.642		56124900	0.890	4S	0.775		56125012	0.720	US	****	4	56125100	0.805	4M	0.576	
56124912	0.917	4M	0.617		56125000	0.866	4M	0.657		56125112	0.545	UM	****	22	56125200	0.822	16M	0.659	
56125012	0.695	UM	****	8	56125100	0.375	UM	****	20	56125212	0.896	1M	0.726		56125300	0.849	20M	0.632	
56125112	0.722	UM	****	10	56125200	0.795	UM	****	3	56125312	0.783	UM	****	4	56125400	0.960	4S	0.764	
56125212	0.857	4S	0.788		56125300	0.926	3S	0.672		56125412	0.857	3M	0.776		56125500	0.962	4M	0.759	
56125312	0.802	1M	0.845	4	56125400	0.999	1M	0.677	4	56125512	0.912	1S	0.738		56125600	0.766	UM	****	8
56125412	0.725	US	****	4	56125500	0.818	1M	0.512		56125612	0.701	UM	****	4	56125700	0.881	9M	0.725	
56125512	0.671	UM	****	13	56125600	0.844	12M	0.854	9*	56125712	0.766	UM	****	10	56125800	0.865	13M	0.850	6*
56125612	0.861	9M	0.750		56125700	0.869	21M	0.773		56125812	1.000	21M	0.717		56125900	0.865	13M	0.850	

58121312	0.626	UM	****	8	58121400	C.618	UM	****	19	58121412	0.922	10S	0.837	6	58121500	0.876	10M	0.868	19*
58121512	0.930	9M	0.795		58121600	C.776	UM	****	10	58121612	0.874	6M	0.735		58121700	0.924	6M	0.745	
58121712	0.839	6M	0.798		58121800	C.843	2M	C.811	14*	58121812	0.863	2S	0.738		58121900	0.956	2M	0.726	
58121912	0.937	2M	0.747		58122000	0.907	2M	0.794		58122012	0.967	2M	0.732		58122100	0.951	2S	0.825	13
58122112	0.901	12M	0.807	23	58122200	0.916	6M	0.796		58122212	0.873	18M	0.713		58122300	0.896	2M	0.856	2*
58122312	0.922	2M	0.844	2*	58122300	0.927	2M	C.863	2	58122312	0.923	2M	0.798		58122500	0.845	15M	0.711	
58122512	0.839	6M	0.644		58122500	0.730	UM	****	15	58122612	0.880	1M	0.653		58122700	0.852	1M	0.788	
58122712	0.623	UM	****	1	58122800	0.694	UM	****	2	58122812	0.841	5M	0.673		58122900	0.937	14M	0.688	
58122912	0.844	14M	0.732		58123000	0.696	UM	****	20	58123012	0.730	UM	****	6	58123100	0.714	UM	****	6
58123112	0.844	7S	0.769		58123100	0.944	1S	0.634		58123112	0.935	1S	0.613		58123200	0.850	1S	0.570	
58123212	0.796	US	****	3	58123300	0.825	1S	0.615		58123312	0.932	1S	0.634		58123400	0.947	1S	0.719	
58123412	0.935	1S	0.736		58123500	0.869	1S	0.688		58123512	0.685	UM	****	20	58123600	0.863	21M	0.815	23*
58123612	0.818	21M	0.754		58123600	0.761	UM	****	23	58123712	0.756	UM	****	23	58123800	0.671	UM	****	11
58123812	0.817	9M	0.745		58123900	0.843	15M	0.759		58123912	0.845	6M	0.833	23*	58124000	0.790	UM	****	5
58124012	0.822	6M	0.819	6*	58124000	0.857	19M	0.814	5*	58124112	0.809	19M	0.790		58124200	0.816	20M	0.775	
58124212	0.852	7M	0.810	18*	58124100	0.846	7M	0.789		58124212	0.856	13M	0.802	6	58124300	0.967	1M	0.756	
58124412	0.839	3M	0.800	3	58124200	0.847	3M	0.713		58124312	0.754	UM	****	2	58124400	0.971	2M	0.719	
58124612	0.900	2M	0.789		58124300	0.846	6M	0.792		58124412	0.887	7M	0.807	5	58124500	0.839	7M	0.815	3*
58124812	0.896	1M	0.807	4	58124400	0.893	1S	0.879	4*	58124512	0.906	1S	0.811	4	58124600	0.865	1S	0.846	4*
58125012	0.836	1S	0.786		58124500	0.912	1S	C.612		58124612	0.925	1M	0.792		58124700	0.906	1M	0.849	4
58125212	0.859	3M	0.819	3*	58124600	0.808	1M	C.618	4	58124712	0.920	3M	0.730		58124800	0.923	1M	0.851	18
58125412	0.871	3M	0.831	3*	58124700	0.916	3M	C.754		58124812	0.902	3M	0.832	3	58124900	0.971	3M	0.733	
58125612	0.898	3M	0.667		58124800	0.961	1M	0.829	18	58124912	0.936	UM	****	1	58125000	0.896	10M	0.864	3*
58125812	0.915	1M	0.730		58124900	0.861	1M	0.667		58125012	0.902	17M	0.764		58125100	0.748	US	****	8
58126012	0.750	UM	****	12	58125000	0.765	UM	****	12	58125112	0.813	1M	0.679		58125200	0.645	UM	****	9
58126212	0.569	UM	****	9	58125100	0.605	UM	****	20	58125212	0.862	3M	0.696		58125300	0.979	1M	0.732	
58126412	0.884	10M	0.819	21	58125200	0.950	1M	0.734		58125312	0.877	7M	0.652	1*	58125400	0.889	5M	0.821	2
58126612	0.738	UM	****	6	58125300	0.919	1M	C.660	18	58125412	0.946	17S	0.812		58125500	0.963	4M	0.689	
58126812	0.752	UM	****	1	58125400	0.584	UM	****	12	58125512	0.721	UM	****	3	58125600	0.639	UM	****	2
58127012	0.748	UM	****	10	58125500	0.816	13M	0.733		58125612	0.896	5M	0.721		58125700	0.756	US	****	1
58127212	0.941	5M	0.759		58125600	0.871	5M	0.703		58125712	0.877	7M	0.652		58125800	0.727	UM	****	12
58127412	0.822	4M	0.718		58125700	0.844	4M	0.831	8*	58125812	0.864	14S	0.682		58125900	0.854	11M	0.936	9*
58127612	0.816	3M	0.759		58125800	0.867	1M	0.686		58125912	0.863	13M	0.731		58126000	0.583	UM	****	10
58127812	0.821	8M	0.818	12*	58125900	0.904	5S	0.691		58126012	0.778	UM	****	20	58126100	0.745	UM	****	21
58128012	0.768	UM	****	1	58126000	0.714	UM	****	12	58126112	0.863	13M	0.731		58126200	0.864	5M	0.850	9*
58128212	0.772	UM	****	12	58126100	0.674	UM	****	8	58126212	0.863	14M	0.691		58126300	0.674	US	****	3
58128412	0.943	UM	****	4	58126200	0.927	3M	0.658		58126312	0.898	14M	0.806	7	58126400	0.964	7M	0.667	
58128612	0.783	UM	****	10	58126300	0.805	14M	C.773		58126412	0.864	UM	****	20	58126500	0.791	UM	****	20
58128812	0.523	UM	****	14	58126400	0.781	UM	****	20	58126512	0.764	UM	****	20	58126600	0.603	UM	****	17*
58129012	0.875	1M	0.626		58126500	0.732	UM	****	22	58126612	0.876	UM	****	1	58126700	0.837	3M	0.469	
58129212	0.572	UM	****	8	58126600	0.759	UM	****	16	58126712	0.778	UM	****	1	58126800	0.887	2S	0.856	13*
58129412	0.497	UM	****	1	58126700	0.513	UM	****	17	58126812	0.863	14S	0.838	20*	58126900	0.767	UM	****	8
58129612	0.914	2M	0.805	10	58126800	0.948	2M	0.834	13	58126912	0.925	6M	0.743		58127000	0.849	6M	0.336	20
58129812	0.693	UM	****	6	58126900	0.915	7M	0.726		58127012	0.955	12M	0.824	9	58127100	0.603	UM	****	20
58130012	0.623	UM	****	14	58127000	0.908	14S	0.855	7*	58127112	0.837	3M	0.656		58127200	0.837	3M	0.469	
58130212	0.676	UM	****	18	58127100	0.836	10M	0.728		58127212	0.946	2S	0.804	9	58127300	0.887	2S	0.856	13*
58130412	0.805	3M	0.523		58127200	0.865	8M	0.860	7*	58127312	0.804	5M	0.669		58127400	0.989	5M	0.753	
58130612	0.873	5M	0.854	13*	58127300	0.877	5S	0.841	13*	58127412	1.000	5M	0.772		58127500	0.989	5M	0.753	
58130812	0.776	UM	****	2	58127400	0.846	5M	0.929	2	58127512	0.824	17M	0.744		58127600	0.784	UM	****	10
58131012	0.954	5M	0.694		58127500	0.846	5M	0.910	9*	58127612	0.530	UM	****	13	58127700	0.806	14M	0.579	
58131212	0.847	21M	0.815	23*	58127600	0.744	15M	C.763		58127712	0.641	UM	****	3	58127800	0.661	UM	****	2
58131412	1.000	14M	0.699		58127700	0.604	UM	****	20	58127812	0.534	UM	****	22	58127900	0.768	UM	****	3
58131612	0.567	UM	****	7	58127800	0.604	UM	****	23	58127912	0.534	US	****	6	58128000	0.942	1M	0.799	
58131812	0.856	3M	0.794		58127900	0.732	UM	****	4	58128012	0.881	3M	0.495		58128100	0.903	1M	0.867	18*
58132012	0.937	3M	0.709		58128000	0.965	3M	0.789		58128112	0.862	10M	0.846	6*	58128200	0.873	9M	0.834	9*
58132212	0.852	3M	0.627		58128100	0.763	UM	****	4	58128212	0.719	UM	****	24	58128300	0.799	UM	****	12
58132412	0.833	15M	0.828	16*	58128200	0.915	13M	C.635		58128312	0.728	UM	****	20	58128400	0.784	UM	****	23
58132612	0.626	UM	****	12	58128300	0.849	5M	0.723		58128412	0.917	6M	0.794		58128500	0.911	6M	0.840	23
58132812	0.902	6M	0.821	23	58128400	C.678	15M	0.812	5	58128512	0.917	6M	0.794		58128600	0.911	6M	0.840	23

50011212	0.850	2M	0.761	7*	60011300	0.926	2M	0.762	23*	60011312	0.929	2M	0.743	23	60011400	0.914	2S	0.794	22
60011412	0.854	12M	3.837		60011500	0.934	12M	0.827	12	60011512	0.936	UM	0.857	12	60011600	0.609	UM	0.794	22
60011612	0.814	22M	0.508		60011700	0.716	UM	0.716		60011712	0.944	4M	0.857	12	60011800	0.961	SS	0.869	22
60011812	0.928	5M	0.723		60011900	0.798	UM	0.798	1	60011912	0.864	4M	0.857	12	60012000	0.665	UM	0.869	22
60012012	0.831	10M	0.771		60012100	0.744	UM	0.744	7	60012112	0.783	UM	0.857	12	60012200	0.911	14M	0.750	4
60012212	0.844	12M	0.689		60012300	0.596	UM	0.596	3	60012312	0.565	UM	0.857	12	60012400	0.784	UM	0.750	4
60012412	0.962	1M	0.784		60012500	0.971	3M	0.870	5	60012512	0.973	3M	0.700	3	60012600	0.870	3M	0.632	3
60012612	0.890	1M	0.698		60012700	0.885	10M	0.846	3*	60012712	0.824	10M	0.689	3	60012800	0.770	UM	0.632	3
60012812	0.819	24M	0.752		60012900	0.902	9S	0.655		60012912	0.878	9M	0.774	9	60013000	0.817	9M	0.793	19
60013012	0.843	15M	0.757		60013100	0.912	2M	0.844	9	60013112	0.953	2S	0.928	9	60013200	0.832	14S	0.930	20*
60013212	0.819	24M	0.752		60013300	0.866	6M	0.764		60013312	0.947	6M	0.704		60013400	0.923	6S	0.793	
60013412	0.536	UM	0.801	19	60013500	0.927	2M	0.817	23*	60013512	0.848	11M	0.683		60013600	0.554	UM	0.793	
60013612	0.535	15S	0.801	19	60013700	0.836	18M	0.763		60013712	0.839	2M	0.748	14*	60013800	0.890	6S	0.685	15
60013812	0.714	UM	0.801	5	60013900	0.889	18S	0.878	5*	60013912	0.828	6M	0.824		60013900	0.863	6M	0.768	
60014012	0.263	6S	0.741	5	60014100	0.889	UM	0.878	5*	60014112	0.874	14M	0.690		60014200	0.788	UM	0.768	
60014212	0.779	UM	0.787		60014300	0.912	2M	0.861	13	60014312	0.939	2M	0.847	13	60014400	0.853	12S	0.849	7*
60014412	0.835	2M	0.774		60014500	0.769	UM	0.769	5	60014512	0.840	12M	0.761		60014600	0.806	2M	0.763	
60014612	0.804	12M	0.774		60014700	0.923	5M	0.873	17*	60014712	1.000	19M	0.753		60014800	0.803	19M	0.545	
60014812	0.952	6M	0.752		60014900	0.650	3M	0.650	9	60014912	0.723	UM	0.857	6	60014900	0.793	UM	0.545	
60015012	0.675	UM	0.896	18*	60015100	0.787	UM	0.787	18	60015112	0.889	14M	0.816	7	60015200	0.875	12M	0.922	16
60015212	0.809	7M	0.896	18*	60015300	0.510	UM	0.510	23	60015312	0.671	UM	0.744	2	60015400	0.847	5M	0.794	
60015412	0.710	UM	0.669	15	60015500	0.729	UM	0.729	11	60015512	0.851	1M	0.744	2	60015600	0.891	1M	0.760	
60015612	0.941	5M	0.669	15	60015700	0.741	UM	0.741	2	60015712	0.725	UM	0.744	2	60015800	0.867	22M	0.592	
60015812	0.506	UM	0.746	14	60015900	0.709	UM	0.709	4	60015912	0.790	UM	0.744	2	60015900	0.872	19M	0.830	15*
60016012	0.950	4M	0.746	14	60016100	0.857	20M	0.748		60016112	0.842	12M	0.719		60016200	1.000	7M	0.768	12*
60016212	0.937	UM	0.746	17	60016300	0.926	2M	0.819	2	60016312	0.908	8S	0.847	1	60016400	0.944	5M	0.778	
60016412	0.771	UM	0.746	17	60016500	0.969	2M	0.738		60016512	0.908	8S	0.847	1	60016600	0.944	5M	0.778	
60016612	0.762	UM	0.746	17	60016700	0.939	2S	0.738		60016712	0.733	UM	0.857	17	60016800	0.793	US	0.778	1
60016812	0.937	3M	0.820	3*	60016900	0.956	1M	0.794	21	60016912	0.795	UM	0.857	17	60016900	1.000	20S	0.760	
60017012	0.830	3M	0.676		60017100	0.891	8S	0.690		60017112	0.902	5M	0.591		60017200	0.850	20S	0.697	
60017212	0.870	18S	0.750		60017300	0.822	8M	0.530		60017312	0.937	17M	0.716		60017400	0.759	UM	0.697	4
60017412	0.556	UM	0.750	20	60017500	0.922	2M	0.719		60017512	0.975	6M	0.722		60017600	0.889	7M	0.807	18
60017612	0.736	UM	0.750	20	60017700	0.939	2S	0.879	9	60017712	0.863	6M	0.637		60017800	0.871	6M	0.783	
60017812	0.933	6M	0.783	6	60017900	0.803	7M	0.771		60017912	0.858	12M	0.796		60017900	0.866	6S	0.903	23
60018012	0.844	6M	0.783	6	60018100	0.819	6M	0.814	6*	60018112	0.748	UM	0.857	5	60018200	0.797	UM	0.903	5
60018212	0.840	14M	0.614	10*	60018300	0.952	19M	0.825	5*	60018312	0.845	15S	0.830	5*	60018400	0.885	6M	0.777	
60018412	0.455	UM	0.614	10*	60018500	0.693	UM	0.825	5*	60018512	0.594	UM	0.830	5*	60018600	0.901	8M	0.873	7*
60018612	0.813	8M	0.751	22	60018700	0.902	8M	0.688	12	60018712	0.889	11M	0.819	14	60018800	0.845	8M	0.742	
60018812	0.818	4M	0.784		60018900	0.775	UM	0.688	4	60018912	0.958	1S	0.801	17	60018900	0.886	1S	0.874	4*
60019012	0.848	4M	0.784		60019100	0.872	1M	0.795		60019112	0.899	6M	0.863	7*	60019200	0.902	2S	0.860	2*
60019212	0.859	12M	0.858	16*	60019300	0.777	UM	0.795	3	60019312	0.899	14M	0.836	7	60019400	0.880	2M	0.878	9*
60019412	0.856	UM	0.858	16*	60019500	0.699	UM	0.795	3	60019512	0.899	14M	0.836	7	60019600	0.862	14M	0.848	20*
60019612	0.820	13M	0.668	20	60019700	0.928	10M	0.874	14	60019712	0.921	7M	0.817	5	60019800	0.908	6M	0.767	
60019812	0.878	7M	0.763		60019900	0.884	10M	0.780	3	60019912	0.658	UM	0.817	5	60019900	0.840	17M	0.569	
60020012	0.878	7M	0.763		60020100	0.832	9M	0.746		60020112	0.781	UM	0.817	5	60020200	0.923	9M	0.569	
60020212	0.848	9M	0.558	10	60020300	0.673	UM	0.746		60020312	0.827	9M	0.832	20*	60020400	0.853	7M	0.784	21
60020412	0.677	UM	0.558	10	60020500	0.899	12M	0.765	2	60020512	0.858	15M	0.804	7	60020600	0.811	16M	0.663	
60020612	0.670	US	0.558	10	60020700	0.899	3M	0.765		60020712	0.900	17M	0.595		60020800	0.807	3M	0.663	21
60020812	0.664	UM	0.558	10	60020900	0.874	3M	0.765		60020912	0.858	15M	0.804	7	60021000	0.811	16M	0.663	
60021012	0.905	8M	0.715	8	60021100	0.693	UM	0.765	17	60021112	0.687	UM	0.838	2*	60021200	0.607	US	0.663	21
60021212	0.644	UM	0.715	8	60021300	0.892	2M	0.765	2*	60021312	0.850	2M	0.838	2*	60021400	0.607	US	0.663	21
60021412	0.938	8M	0.715	8	60021500	0.892	2M	0.765	2*	60021512	0.850	2M	0.838	2*	60021600	0.607	US	0.663	21
60021612	0.938	8M	0.715	8	60021700	0.892	2M	0.765	2*	60021712	0.850	2M	0.838	2*	60021800	0.607	US	0.663	21
60021812	0.819	3M	0.616		60021900	1.000	17M	0.599		60021912	0.816	11M	0.655		60021900	0.861	13M	0.695	18
60022012	0.926	9M	0.670	4	60022100	0.919	7M	0.709		60022112	0.873	19M	0.739	20	60022200	0.929	1M	0.818	18
60022212	0.926	9M	0.670	4	60022300	0.888	3M	0.760		60022312	0.951	21S	0.806	20	60022400	0.817	1M	0.770	
60022412	0.926	9M	0.670	4	60022500	0.919	7M	0.760		60022512	0.873	19M	0.739	20	60022600	0.916	6M	0.900	17*
60022612	0.926	9M	0.670	4	60022700	0.888	3M	0.760		60022712	0.951	21S	0.806	20	60022800	0.817	1M	0.770	
60022812	0.926	9M	0.670	4	60022900	0.919	7M	0.760		60022912	0.873	19M	0.739	20	60023000	0.916	6M	0.900	17*
60023012	0.926	9M	0.670	4	60023100	0.888	3M	0.760		60023112	0.951	21S	0.806	20	60023200	0.817	1M	0.770	
60023212	0.926	9M	0.670	4	60023300	0.919	7M	0.760		60023312	0.873	19M	0.739	20	60023400	0.916	6M	0.900	17*
60023412	0.926	9M	0.670	4	60023500	0.888	3M	0.760		60023512	0.951	21S	0.806	20	60023600	0.817	1M	0.770	
60023612	0.926	9M	0.670	4	60023700	0.919	7M	0.760		60023712	0.873	19M	0.739	20	60023800	0.916	6M	0.900	17*
60023812	0.926	9M	0.670	4	60023900	0.888	3M	0.760		60023912	0.951	21S	0.806	20	60024000	0.817	1M	0.770	
60024012	0.926	9M	0.670	4	60024100	0.919	7M	0.760		60024112	0.873	19M	0.739	20	60024200	0.916	6M	0.900	17*
60024212	0.926	9M	0.670	4	60024300	0.888	3M	0.760		60024312	0.951	21S	0.806	20	60024400	0.817	1M	0.770	
600244																			

62012312	0.863	15	0.787	62012412	0.843	22M	0.678	62012512	0.837	16S	0.816	11*	62012612	0.944	3M	0.676
62012712	0.933	17M	0.523	62012812	0.781	UM	*****	62012912	0.850	3M	0.751	11*	62013012	0.740	UM	*****
62013112	0.950	2M	0.729	62020112	0.812	15M	0.811	62020212	0.719	UM	*****	1	62020312	0.878	1M	0.724
62022412	0.795	UM	*****	62020512	0.594	UM	*****	62020612	0.809	8M	0.715	1	62020712	0.864	2M	0.835
62020912	0.765	2M	0.765	62020912	0.899	21M	0.660	62021012	0.847	10M	0.834	1	62021112	0.929	2M	0.733
62020912	0.854	5*	0.854	62021312	0.913	6M	0.808	62021412	0.906	18M	0.797	1	62021512	0.910	2M	0.835
62021612	0.892	15M	0.739	62021712	0.902	6M	0.802	62021812	0.925	19M	0.834	5	62021912	0.721	UM	*****
62022012	0.951	8M	0.785	62022112	0.977	2M	0.758	62022212	0.889	16M	0.652	1	62022312	0.894	4S	0.817
62022412	0.866	1M	0.690	62022512	0.738	UM	*****	62022612	0.808	8M	0.616	18	62022712	0.750	UM	*****
62022812	0.812	18M	0.673	62022912	0.738	7M	0.747	62023012	0.655	UM	*****	5	62023112	0.745	UM	*****
62023012	0.855	9M	0.673	62023112	0.839	7M	0.747	62023212	0.751	UM	*****	5	62023312	0.563	UM	*****
62023412	0.833	5M	0.704	62023512	0.799	UM	*****	62023612	0.849	11S	0.826	20*	62023712	0.699	UM	*****
62023612	0.738	UM	*****	62023712	0.891	2M	0.866	62023812	0.822	1M	0.726	21	62023912	0.871	1M	0.721
62023812	0.892	1M	0.819	62023912	0.647	UM	*****	62024012	0.624	UM	0.839	13*	62024112	0.704	UM	*****
62024012	0.892	1M	0.819	62024112	0.817	16M	0.808	62024212	0.624	UM	0.839	13*	62024312	0.738	UM	*****
62024212	0.892	1M	0.819	62024312	0.817	16M	0.808	62024412	0.624	UM	0.839	13*	62024512	0.920	2M	0.711
62024412	0.892	1M	0.819	62024512	0.817	16M	0.808	62024612	0.624	UM	0.839	13*	62024712	0.920	2M	0.711
62024612	0.892	1M	0.819	62024712	0.817	16M	0.808	62024812	0.624	UM	0.839	13*	62024912	0.920	2M	0.711
62024812	0.892	1M	0.819	62024912	0.817	16M	0.808	62025012	0.624	UM	0.839	13*	62025112	0.920	2M	0.711
62025012	0.892	1M	0.819	62025112	0.817	16M	0.808	62025212	0.624	UM	0.839	13*	62025312	0.920	2M	0.711
62025212	0.892	1M	0.819	62025312	0.817	16M	0.808	62025412	0.624	UM	0.839	13*	62025512	0.920	2M	0.711
62025412	0.892	1M	0.819	62025512	0.817	16M	0.808	62025612	0.624	UM	0.839	13*	62025712	0.920	2M	0.711
62025612	0.892	1M	0.819	62025712	0.817	16M	0.808	62025812	0.624	UM	0.839	13*	62025912	0.920	2M	0.711
62025812	0.892	1M	0.819	62025912	0.817	16M	0.808	62026012	0.624	UM	0.839	13*	62026112	0.920	2M	0.711
62026012	0.892	1M	0.819	62026112	0.817	16M	0.808	62026212	0.624	UM	0.839	13*	62026312	0.920	2M	0.711
62026212	0.892	1M	0.819	62026312	0.817	16M	0.808	62026412	0.624	UM	0.839	13*	62026512	0.920	2M	0.711
62026412	0.892	1M	0.819	62026512	0.817	16M	0.808	62026612	0.624	UM	0.839	13*	62026712	0.920	2M	0.711
62026612	0.892	1M	0.819	62026712	0.817	16M	0.808	62026812	0.624	UM	0.839	13*	62026912	0.920	2M	0.711
62026812	0.892	1M	0.819	62026912	0.817	16M	0.808	62027012	0.624	UM	0.839	13*	62027112	0.920	2M	0.711
62027012	0.892	1M	0.819	62027112	0.817	16M	0.808	62027212	0.624	UM	0.839	13*	62027312	0.920	2M	0.711
62027212	0.892	1M	0.819	62027312	0.817	16M	0.808	62027412	0.624	UM	0.839	13*	62027512	0.920	2M	0.711
62027412	0.892	1M	0.819	62027512	0.817	16M	0.808	62027612	0.624	UM	0.839	13*	62027712	0.920	2M	0.711
62027612	0.892	1M	0.819	62027712	0.817	16M	0.808	62027812	0.624	UM	0.839	13*	62027912	0.920	2M	0.711
62027812	0.892	1M	0.819	62027912	0.817	16M	0.808	62028012	0.624	UM	0.839	13*	62028112	0.920	2M	0.711
62028012	0.892	1M	0.819	62028112	0.817	16M	0.808	62028212	0.624	UM	0.839	13*	62028312	0.920	2M	0.711
62028212	0.892	1M	0.819	62028312	0.817	16M	0.808	62028412	0.624	UM	0.839	13*	62028512	0.920	2M	0.711
62028412	0.892	1M	0.819	62028512	0.817	16M	0.808	62028612	0.624	UM	0.839	13*	62028712	0.920	2M	0.711
62028612	0.892	1M	0.819	62028712	0.817	16M	0.808	62028812	0.624	UM	0.839	13*	62028912	0.920	2M	0.711
62028812	0.892	1M	0.819	62028912	0.817	16M	0.808	62029012	0.624	UM	0.839	13*	62029112	0.920	2M	0.711
62029012	0.892	1M	0.819	62029112	0.817	16M	0.808	62029212	0.624	UM	0.839	13*	62029312	0.920	2M	0.711
62029212	0.892	1M	0.819	62029312	0.817	16M	0.808	62029412	0.624	UM	0.839	13*	62029512	0.920	2M	0.711
62029412	0.892	1M	0.819	62029512	0.817	16M	0.808	62029612	0.624	UM	0.839	13*	62029712	0.920	2M	0.711
62029612	0.892	1M	0.819	62029712	0.817	16M	0.808	62029812	0.624	UM	0.839	13*	62029912	0.920	2M	0.711
62029812	0.892	1M	0.819	62029912	0.817	16M	0.808	62030012	0.624	UM	0.839	13*	62030112	0.920	2M	0.711
62030012	0.892	1M	0.819	62030112	0.817	16M	0.808	62030212	0.624	UM	0.839	13*	62030312	0.920	2M	0.711
62030212	0.892	1M	0.819	62030312	0.817	16M	0.808	62030412	0.624	UM	0.839	13*	62030512	0.920	2M	0.711
62030412	0.892	1M	0.819	62030512	0.817	16M	0.808	62030612	0.624	UM	0.839	13*	62030712	0.920	2M	0.711
62030612	0.892	1M	0.819	62030712	0.817	16M	0.808	62030812	0.624	UM	0.839	13*	62030912	0.920	2M	0.711
62030812	0.892	1M	0.819	62030912	0.817	16M	0.808	62031012	0.624	UM	0.839	13*	62031112	0.920	2M	0.711
62031012	0.892	1M	0.819	62031112	0.817	16M	0.808	62031212	0.624	UM	0.839	13*	62031312	0.920	2M	0.711
62031212	0.892	1M	0.819	62031312	0.817	16M	0.808	62031412	0.624	UM	0.839	13*	62031512	0.920	2M	0.711
62031412	0.892	1M	0.819	62031512	0.817	16M	0.808	62031612	0.624	UM	0.839	13*	62031712	0.920	2M	0.711
62031612	0.892	1M	0.819	62031712	0.817	16M	0.808	62031812	0.624	UM	0.839	13*	62031912	0.920	2M	0.711
62031812	0.892	1M	0.819	62031912	0.817	16M	0.808	62032012	0.624	UM	0.839	13*	62032112	0.920	2M	0.711
62032012	0.892	1M	0.819	62032112	0.817	16M	0.808	62032212	0.624	UM	0.839	13*	62032312	0.920	2M	0.711
62032212	0.892	1M	0.819	62032312	0.817	16M	0.808	62032412	0.624	UM	0.839	13*	62032512	0.920	2M	0.711
62032412	0.892	1M	0.819	62032512	0.817	16M	0.808	62032612	0.624	UM	0.839	13*	62032712	0.920	2M	0.711
62032612	0.892	1M	0.819	62032712	0.817	16M	0.808	62032812	0.624	UM	0.839	13*	62032912	0.920	2M	0.711
62032812	0.892	1M	0.819	62032912	0.817	16M	0.808	62033012	0.624	UM	0.839	13*	62033112	0.920	2M	0.711
62033012	0.892	1M	0.819	62033112	0.817	16M	0.808	62033212	0.624	UM	0.839	13*	62033312	0.920	2M	0.711
62033212	0.892	1M	0.819	62033312	0.817	16M	0.808	62033412	0.624	UM	0.839	13*	62033512	0.920	2M	0.711
62033412	0.892	1M	0.819	62033512	0.817	16M	0.808	62033612	0.624	UM	0.839	13*	62033712	0.920	2M	0.711
62033612	0.892	1M	0.819	62033712	0.817	16M	0.808	62033812	0.624	UM	0.839	13*	62033912	0.920	2M	0.711
62033812	0.892	1M	0.819	62033912	0.817	16M	0.808	62034012	0.624	UM	0.839	13*	62034112	0.920	2M	0.711
62034012	0.892	1M	0.819	62034112	0.817	16M	0.808	62034212	0.624	UM	0.839	13*	62034312	0.920	2M	0.711
62034212	0.892	1M	0.819	62034312	0.817	16M	0.808	62034412	0.624	UM	0.839	13*	62034512	0.920	2M	0.711
62034412	0.892	1M	0.819	62034512	0.817	16M	0.808	62034612	0.624	UM	0.839	13*	62034712	0.920	2M	0.711
62034612	0.892	1M	0.819	62034712	0.817	16M	0.808	62034812	0.624	UM	0.839	13*	62034912	0.920	2M	0.711
62034812	0.892	1M	0.819	62034912	0.817	16M	0.808	62035012	0.624	UM	0.839	13*	62035112	0.920	2M	0.711
62035012	0.892	1M	0.819	62035112	0.817	16M	0.808	62035212	0.624	UM	0.839	13*	62035312	0.920	2M	0.711
62035212	0.892	1M	0.819	62035312	0.817	16M	0.808	62035412	0.624	UM	0.839	13*	62035512	0.920	2M	0.711
62035412	0.892	1M	0.819	62035512	0.817	16M	0.808	62035612	0.624	UM	0.839	13*	62035712	0.920	2M	0.711
62035612	0.892	1														

63121212	0.787	US	****	2	63121300	0.940	9S	0.831	7	63121312	0.861	5M	0.828	13*	63121400	0.863	11M	0.692
63121412	0.712	UM	*****	16	63121500	0.826	7M	0.674	4	63121512	0.889	10M	0.772		63121600	0.795	UM	****
63121612	0.762	UM	*****	4	63121700	0.699	UM	*****		63121712	0.852	1M	0.646		63121800	0.939	1M	0.777
63121812	0.809	10M	0.805	3	63121900	0.858	2M	0.680		63121912	0.812	2M	0.806	2*	63122000	0.926	8M	0.784
63122012	0.950	8M	0.804	7	63122100	0.950	8M	0.706		63122112	1.000	8M	0.772		63122200	0.946	8M	0.818
63122212	0.862	2M	0.703		63122300	0.778	UM	*****	18	63122312	0.966	10M	0.823	3	63122400	0.865	20M	0.847
63122412	0.928	20M	0.812	18	63122500	0.772	UM	*****	10	63122512	0.744	UM	*****	2	63122600	0.769	UM	****
63122612	0.830	20M	0.772		63122700	0.872	20M	0.788		63122712	0.796	UM	*****	18	63122800	0.928	8M	0.640
63122812	0.981	8M	0.780		63122900	0.935	8M	0.889	12*	63122912	0.970	5M	0.841	2	63123000	0.926	5S	0.862
63123012	0.915	5M	0.738		63123100	0.667	UM	*****	4	63123112	0.648	UM	*****	19	64010100	0.665	UM	****
64010112	0.806	12M	0.762		64010200	0.866	6M	0.654		64010212	0.589	UM	*****	15	64010300	0.792	UM	****
64010312	0.875	18M	0.736		64010400	0.868	2M	0.966	2*	64010412	0.640	5M	0.762		64010500	0.877	8M	0.831
64010512	0.903	2M	0.875	9*	64010600	0.824	12M	0.683		64010612	0.733	UM	*****	6	64010700	0.911	1M	0.730
64010712	0.874	1M	0.676		64010800	0.667	UM	*****	4	64010812	0.867	5M	0.796		64010900	0.855	5M	0.827
64010912	0.888	11M	0.715		64011000	0.892	21M	0.745		64011012	0.762	UM	*****	22	64011100	0.820	4M	0.736
64011112	0.838	4M	0.790		64011200	0.712	UM	*****	8	64011212	0.795	UM	*****	9	64011300	0.866	2M	0.791
64011312	0.855	12M	0.795		64011400	0.730	US	*****	5	64011412	0.829	1M	0.815	6*	64011500	0.844	20M	0.733
64011512	0.888	2M	0.793		64011600	0.960	2M	0.721		64011612	0.929	2M	0.746		64011700	0.838	6M	0.832
64011712	0.922	6M	0.704		64011800	0.890	7M	0.795		64011812	0.793	UM	*****	11	64011900	0.769	UM	****
64011912	0.757	UM	*****	11	64012000	0.873	13M	0.922	6	64012012	0.800	13M	0.792		64012100	0.823	5M	0.803
64012112	0.792	UM	*****	1	64012200	0.811	4M	0.907	8*	64012212	0.795	UM	*****	12	64012300	0.866	2M	0.791
64012312	0.769	UM	*****	12	64012400	0.570	UM	*****	12	64012412	0.637	UM	*****	15	64012500	0.491	UM	****
64012512	0.724	UM	*****	17	64012600	0.523	UM	*****	24	64012612	0.858	5M	0.762		64012700	0.931	14M	0.712
64012712	0.565	UM	*****	6	64012800	0.923	10M	0.840	6	64012812	0.757	UM	*****	10	64012900	0.925	2M	0.748
64012912	0.937	2M	0.819	13	64013000	0.894	11M	0.841	23	64013012	0.631	UM	*****	23	64013100	0.713	UM	****
64013112	0.671	UM	*****	8	64020100	0.794	UM	*****	10	64020112	0.719	UM	*****	7	64020200	0.950	5M	0.609
64020212	0.909	5M	0.665		64020300	0.813	5M	0.666		64020312	0.654	UM	*****		64020400	0.692	UM	****
64020412	0.706	UM	*****	4	64020500	0.808	23M	0.799		64020512	0.594	UM	*****	14	64020600	0.822	8M	0.659
64020612	0.860	8S	0.850	12*	64020700	0.910	5M	0.796	8	64020712	0.431	UM	*****	15	64020800	0.893	5M	0.735
64020812	0.911	5M	0.595		64020900	0.725	UM	*****		64020912	0.740	UM	*****	8	64021000	0.895	14M	0.705
64021012	0.779	UM	*****	6	64021100	0.819	7M	0.812	17*	64021112	0.856	1M	0.665		64021200	0.736	UM	****
64021212	0.840	14M	0.803	20*	64021300	0.864	7M	0.762		64021312	0.822	1M	0.773		64021400	0.815	10M	0.691
64021412	0.863	9M	0.690		64021500	0.766	US	*****	10	64021512	0.816	6M	0.787		64021600	0.844	7M	0.842
64021612	0.847	7M	0.825	5*	64021700	0.887	7M	0.606	5	64021712	0.929	7M	0.773		64021800	0.713	UM	****
64021812	0.927	9M	0.768		64021900	0.853	6M	0.710		64021912	0.730	UM	*****	10	64021950	0.650	14M	0.827
64022012	0.763	UM	*****	5	64022100	0.795	US	*****	14	64022112	0.901	5S	0.666	17*	64022200	0.854	18M	0.673
64022212	0.904	2M	0.872	2*	64022300	0.816	11M	0.803	7*	64022312	0.750	UM	*****	6	64022350	0.869	23S	0.792
64022412	0.680	UM	*****	15	64022500	0.531	UM	*****	14	64022512	0.923	2M	0.738		64022600	0.606	UM	****
64022612	0.746	UM	*****	3	64022700	0.824	1M	0.735		64022712	0.829	2M	0.721		64022800	0.740	UM	****
64022812	0.965	6M	0.726		64022900	0.842	7M	0.815	5*	64022912	0.858	7M	0.836	5+	64120100	0.887	4M	0.833
64120112	0.351	17M	0.727		64120200	0.910	5M	0.678	2*	64120212	0.901	5S	0.666		64120300	0.744	UM	****
64120312	0.611	UM	*****	20	64120400	0.675	UM	*****	9	64120412	0.813	11M	0.702		64120500	0.832	5M	0.770
64120512	0.804	5M	0.690		64120600	0.681	14M	0.634		64120612	0.801	1M	0.630		64120700	0.640	UM	****
64120712	0.818	14S	0.728	3	64120800	0.791	US	*****	20	64120912	0.717	US	*****	20	64120950	0.613	UM	****
64120912	0.792	UM	*****		64121000	0.915	2M	0.787		64121012	0.849	10S	0.712		64121100	0.764	US	****
64121112	0.826	16M	0.693		64121200	0.744	US	*****	18	64121212	0.874	13M	0.767		64121300	0.943	13M	0.832
64121312	0.863	13M	0.772		64121400	0.840	1M	0.780		64121412	0.866	1M	0.760		64121500	0.860	1S	0.801
64121512	0.866	3S	0.784		64121600	0.892	3S	0.874	1*	64121612	0.883	4S	0.836	4*	64121700	0.879	3M	0.740
64121712	0.871	3M	0.731		64121800	0.834	1M	0.796		64121812	0.847	3M	0.810		64121900	0.904	3S	0.718
64121912	0.895	3S	0.763		64122000	0.872	3S	0.782		64122012	0.849	3S	0.744		64122100	0.765	US	****
64122112	0.955	4S	0.637	4	64122200	0.732	US	*****	1	64122212	0.631	US	*****	22	64122300	0.713	US	****
64122312	0.688	US	*****		64122400	0.533	UM	*****	4	64122412	0.510	UM	*****	1	64122500	0.492	UM	****
64122512	0.658	UM	*****	11	64122600	0.622	UM	*****	11	64122612	0.633	UM	*****	16	64122700	0.743	UM	****
64122712	0.854	14M	0.802	24	64122800	0.630	UM	*****	11	64122812	0.679	UM	*****	15	64122900	0.776	UM	****
64122912	0.741	UM	*****	3	64123000	0.747	UM	*****	11	64123012	0.668	UM	*****	24	64123100	0.654	UM	****
64123112	0.528	UM	*****	16	65010100	0.956	7M	0.764		65010112	0.872	7M	0.805	11	65010200	0.819	13M	0.803
65010212	0.836	1M	0.746		65010300	0.822	1M	0.801	15*	65010312	0.895	23M	0.721		65010400	0.848	19M	0.813
65010412	0.336	19M	0.763		65010500	0.810	19M	0.766		65010512	0.789	UM	*****	17	65010600	0.783	UM	****
65010612	0.810	23M	0.713		65010700	0.682	1M	0.868	6*	65010712	0.916	1M	0.790		65010800	0.889	3S	0.842
65010812	0.937	3S	0.778		65010900	0.972	3S	0.702		65010912	0.961	3M	0.735		65011000	0.921	3M	0.739

65011012	0.812	1M	0.726	65011100	0.840	1M	0.824	4*	65011112	0.815	3M	0.801	3*	65011200	0.747	US	****	21
65011212	0.633	US	****	65011300	0.958	8S	0.837	12	65011312	0.801	15M	0.842	2	65011400	0.941	5M	0.815	13
65011412	0.723	UM	****	65011500	0.821	5M	0.817	8*	65011512	0.870	15M	0.820	12*	65011600	0.713	US	****	20
65011612	0.876	UM	0.621	65011700	0.799	UM	****	7	65011712	0.891	5S	0.806	9	65011800	0.555	US	****	4
65011812	0.826	1M	0.824	65011900	0.765	US	****	7	65011912	0.943	2M	0.735		65012000	0.777	US	****	20
65012012	0.909	19S	0.841	65012100	0.858	6S	0.844	14*	65012112	0.911	2S	0.734		65012200	0.964	2S	0.760	
65012212	0.896	2M	0.818	65012300	0.861	12M	0.706		65012312	0.816	7M	0.752		65012400	0.908	1M	0.849	18
65012412	0.846	1M	0.754	65012500	0.911	1M	0.724		65012512	0.862	7M	0.760		65012600	0.933	1M	0.836	19
65012612	0.863	3M	0.809	65012700	0.867	3M	0.820	8*	65012712	0.827	3M	0.785		65012800	0.796	UM	****	4
65012812	0.574	UM	****	65012900	0.869	UM	****	23	65012912	0.820	19S	0.793		65013000	0.852	18S	0.782	
65013012	0.766	UM	****	65013100	0.857	6M	0.797		65013112	0.812	20M	0.731		65020100	0.843	1M	0.830	18*
65020112	0.944	1M	0.808	65020200	0.916	3M	0.869	3*	65020212	0.907	1M	0.856	4	65020300	0.893	3M	0.849	3*
65020312	0.904	3M	0.609	65020400	0.729	UM	****	6	65020412	0.946	7M	0.764		65020500	0.901	7M	0.785	
65020512	0.808	13M	0.721	65020600	0.823	16M	0.792		65020612	0.695	UM	****	24	65020700	0.930	2M	0.707	
65020712	0.909	2M	0.776	65020800	0.848	21M	0.806	20*	65020812	0.866	13M	0.798		65020900	0.826	1M	0.698	
65020912	0.630	UM	****	65021000	0.931	9M	0.719		65021012	0.806	9M	0.538		65021100	0.904	2M	0.833	2
65021112	0.866	11M	0.732	65021200	0.634	UM	****	24	65021212	0.874	14M	0.801	20	65021300	0.756	US	****	20
65021312	0.836	7S	0.830	65021400	0.832	7S	0.754		65021412	0.834	10S	0.807	3*	65021500	0.754	UM	****	4
65021512	0.637	UM	****	65021500	0.656	UM	****	18	65021612	0.668	UM	****	22	65021700	0.728	UM	****	22
65021712	0.865	17M	0.678	65021800	0.805	17S	0.782		65021812	0.928	17S	0.758		65021900	0.797	UM	****	22
65021912	0.887	16M	0.845	65022000	0.780	UM	****	11	65022012	0.928	1M	0.626		65022100	0.859	3M	0.763	
65022112	0.725	2S	0.716	65022200	0.800	UM	****	13	65022212	0.802	2M	0.716		65022300	0.974	2M	0.707	
65022312	0.930	2S	0.716	65022400	0.764	US	****	5	65022412	0.771	UM	****	19	65022500	0.805	24S	0.724	
65022512	0.776	US	****	65022500	0.769	US	****	11	65022612	0.755	UM	****	18	65022700	0.787	UM	****	18
65022712	0.816	10M	0.700	65022600	0.699	UM	****	8	65022812	0.809	5M	0.744		65022800	0.875	18S	0.800	7
65120112	0.797	US	****	65120300	0.905	6M	0.829	14	65120312	0.916	6M	0.846	17	65120300	0.634	UM	****	1
65120312	0.831	5M	0.759	65120400	0.842	21M	0.776		65120412	0.841	19M	0.769		65120500	0.698	UM	****	21
65120512	0.893	11M	0.860	65120500	0.762	UM	****	20	65120612	0.861	19M	0.851	5*	65120700	0.891	15M	0.819	5
65120712	0.881	15M	0.740	65120600	0.864	15M	0.804	5	65120812	0.856	6M	0.828	14*	65120900	0.843	11M	0.707	
65120912	0.913	11M	0.818	65121000	0.860	5M	0.710		65121012	0.835	5M	0.767	5	65121100	0.834	5M	0.656	
65121112	0.904	5M	0.727	65121200	0.682	UM	****	12	65121212	0.842	5M	0.755		65121300	0.682	UM	****	1
65121312	0.846	4M	0.604	65121300	0.884	4M	0.474		65121412	0.842	5M	0.755		65121500	0.807	2M	0.724	
65121512	0.813	2M	0.728	65121400	0.743	UM	****	18	65121512	0.844	21S	0.731	8	65121700	0.844	17M	0.703	
65121712	0.758	UM	****	65121500	0.805	UM	****	20	65122012	0.813	9M	0.741	11	65122300	0.857	21M	0.745	
65121912	0.685	UM	****	65121800	0.654	UM	****	5	65122412	0.777	US	****	1	65122500	0.721	US	****	15
65122112	0.747	UM	****	65122300	0.744	UM	0.738	15	65122612	0.649	US	****	1	65122700	0.760	UM	****	1
65122312	0.885	13M	0.838	65122400	0.763	US	****	15	65122812	0.886	5S	0.727		65122900	0.755	UM	****	24
65122512	0.832	1M	0.771	65122500	0.878	4M	0.750		65123012	0.875	4M	0.732		65123100	0.740	UM	****	1
65122712	0.811	22M	0.756	65122800	0.907	16M	0.575		65123012	0.875	4M	0.732		65123200	0.824	1M	0.559	
65122912	0.845	16M	0.786	65123000	0.937	13M	0.675		65123112	0.747	UM	****	24	65123300	0.824	1M	0.559	
65123112	0.786	UM	****	65123100	0.832	13M	0.675	22	65123212	0.624	UM	****	24	65123400	0.824	1M	0.559	
65123312	0.732	UM	****	65123200	0.530	UM	****	2	65123312	0.739	US	****	1	65123500	0.780	US	****	12
65123512	0.774	US	****	65123300	0.746	US	****	2	65123412	0.754	US	****	1	65123600	0.807	1M	0.708	
65123712	0.863	5S	0.743	65123400	0.810	17S	0.783		65123512	0.827	17S	0.772		65123700	0.810	3M	0.802	1*
65123912	0.884	16M	0.775	65123500	0.910	16M	0.690		65123612	0.862	13M	0.741		65123800	0.762	UM	****	22
65124112	0.841	17M	0.755	65123600	0.814	UM	****	16	65123712	0.810	11M	0.688	18	65123900	0.789	UM	****	10
65124312	0.878	4M	0.636	65123700	0.810	5M	0.661	15	65123812	0.765	UM	****	18	65124000	0.860	13S	0.727	
65124512	0.741	UM	****	65123800	0.904	7M	0.750		65123912	0.809	4S	0.755		65124100	0.849	UM	****	21
65124712	0.909	7M	0.782	65123900	0.768	US	****	3	65124012	0.828	8M	0.604		65124200	0.921	17M	0.637	
65124912	0.796	US	****	65124000	0.718	UM	****	3	65124112	0.836	17M	0.754		65124300	0.855	8M	0.820	7*
65125112	0.683	UM	****	65124100	0.670	UM	****	2	65124212	0.828	8M	0.604		65124400	0.860	UM	****	14
65125312	0.931	17M	0.673	65124200	0.670	UM	****	5	65124312	0.911	1M	0.739		65124500	0.825	15M	0.751	
65125512	0.860	2M	0.664	65124300	0.776	1S	0.736		65124412	0.827	15S	0.759	5	65124600	0.764	UM	****	5
65125712	0.829	8M	0.565	65124400	0.935	8M	0.736		65124512	0.741	UM	****	2	65124700	0.718	UM	****	8
65125912	0.872	2M	0.726	65124500	0.859	2S	0.709		65124612	0.839	3M	0.676		65124800	0.817	17M	0.648	
65126112	0.744	UM	****	65124600	0.753	UM	****	14	65124712	0.762	UM	****	4	65124900	0.762	UM	****	2
65126312	0.637	UM	****	65124700	0.563	UM	****	8	65124812	0.839	3M	0.676		65125000	0.832	11M	0.835	7*
65126512	0.824	17M	0.681	65124800	0.725	UM	****	22	65124912	0.783	UM	****		65125100	0.832	11M	0.835	
65126712	0.626	UM	****	65124900	0.671	UM	****	13	65125012	0.869	8M	0.693		65125200	0.832	11M	0.835	
65126912	0.909	11M	0.717	65125000	0.515	UM	****		65125112	0.869	8M	0.693		65125300	0.832	11M	0.835	

66020912	0.631	UM	****	24	66021000	0.443	UM	****	12	66021012	0.951	14M	0.650	66021100	0.675	US	****	6	
66021112	0.958	1S	0.812	18	66021200	0.788	US	****	4	66021212	0.824	17M	0.685	66021300	0.798	US	****	22	
66021312	0.874	3M	0.676		66021400	0.807	10M	0.802	3*	66021412	0.918	3M	0.698	66021500	0.760	UM	****	4	
66021512	0.823	20M	0.654		66021600	0.715	UM	****	19	66021612	0.882	7M	0.743	66021700	0.842	7M	0.737		
66021712	0.841	10M	0.767		66021800	0.724	UM	****	6	66021812	0.824	12M	0.764	66021900	0.849	15M	0.848	16*	
66021912	0.859	2M	0.755		66022000	0.830	2M	0.802	23*	66022012	0.836	15M	0.737	66022100	0.829	15M	0.747		
66022112	0.852	2M	0.771		66022200	0.812	2M	0.814	20	66022212	0.835	2M	0.792	66022300	0.946	2M	0.725		
66022312	0.908	11S	0.752		66022400	0.890	11M	0.705		66022412	0.850	5M	0.778	66022500	0.874	5M	0.709		
66022512	0.862	5M	0.746		66022600	0.811	5M	0.777		66022612	0.723	UM	****	2	66022700	0.560	UM	****	20
66022712	0.470	UM	****	3	66022800	0.832	1M	0.586		66022812	0.928	1M	0.681	66120100	0.862	4S	0.712		
66120112	0.717	US	****	1	66120200	0.787	UM	****	22	66120212	0.788	UM	****	11	66120300	0.818	13S	0.777	
66120312	0.830	16S	0.655		66120400	0.899	4M	0.724		66120412	0.907	4M	0.640	66120500	0.853	16M	0.711		
66120512	1.000	16S	0.703		66120600	0.830	16S	0.824	24*	66120612	0.875	22S	0.699	66120700	0.817	22M	0.650		
66120712	0.901	13M	0.650		66120800	0.920	13M	0.732		66120812	0.906	13M	0.779	66120900	0.716	UM	****	16	
66120912	0.676	UM	****	24	66121000	0.701	UM	****	24	66121012	0.708	UM	****	24	66121100	0.739	US	****	1
66121112	0.792	UM	****	1	66121200	0.634	UM	****	8	66121212	0.648	UM	****	7	66121300	0.908	2M	0.767	
66121312	0.840	11M	0.828	7*	66121400	0.922	15M	0.703		66121412	0.815	15M	0.738	66121500	0.805	2M	0.803	14*	
66121512	0.887	2M	0.773		66121600	0.893	11M	0.862	7*	66121612	0.946	11M	0.719	66121700	0.646	UM	****	13	
66121712	0.954	8M	0.839	12*	66121800	0.815	11M	0.803	7*	66121812	0.747	UM	****	13	66121900	0.359	UM	****	23
66121912	0.528	UM	****	13	66122000	0.738	UM	****	23	66122012	0.900	15M	0.676	66122100	0.788	UM	****	24	
66122112	0.809	11M	0.681		66122200	0.644	UM	****	9	66122212	0.573	UM	****	5	66122300	0.663	UM	****	7
66122312	0.839	11M	0.809	7*	66122400	0.886	2M	0.879	13*	66122412	0.903	11M	0.829	66122500	0.957	12M	0.791		
66122512	0.401	UM	****	11	66122600	0.871	1M	0.828	18*	66122612	0.941	20M	0.626	66122700	0.908	8M	0.808	7	
66122712	0.838	11M	0.824	12*	66122800	0.794	UM	****	12	66122812	0.638	UM	****	20	66122900	0.835	6M	0.739	
66122912	0.948	18S	0.806	5*	66123000	0.883	2S	0.813	2	66123012	0.920	11S	0.855	66123100	0.849	11M	0.624		
66123112	0.873	5M	0.840	13*	67010100	0.878	15M	0.817	13	67010112	0.579	UM	****	11	67010200	0.723	UM	****	2
67010212	0.871	8M	0.927	7*	67010300	0.827	12M	0.789		67010312	0.871	6M	0.750	67010400	0.821	6M	0.814	6*	
67010412	0.702	DM	****	10	67010500	0.897	8M	0.739		67010512	0.884	5M	0.868	67010600	0.926	5S	0.747		
67010612	0.953	5M	0.753		67010700	0.953	5M	0.653		67010712	0.897	5M	0.583	67010800	0.810	14M	0.755		
67010812	0.525	UM	****	3	67010900	0.791	UM	****	1	67010912	0.853	4M	0.779	67011000	0.796	UM	****	9	
67011012	0.976	2S	0.767		67011100	0.847	2S	0.807	20*	67011112	0.699	US	****	5	67011200	0.808	19M	0.737	
67011212	0.792	UM	****	17	67011300	0.764	UM	****	6	67011312	0.814	1M	0.729	67011400	0.806	1M	0.705		
67011412	0.880	1M	0.761		67011500	0.815	1M	0.813	4*	67011512	0.716	UM	****	6	67011600	0.486	UM	****	17
67011612	0.742	UM	****	2	67011700	0.853	5M	0.710		67011712	0.238	UM	****	15	67011800	0.691	UM	****	15
67011812	0.896	8M	0.524		67011900	0.931	6S	0.769		67011912	0.889	2M	0.816	67012000	0.765	US	****	23	
67012012	0.849	6S	0.836	23*	67012100	0.819	15M	0.772		67012112	0.637	UM	****	15	67012200	0.606	UM	****	15
67012212	0.682	UM	****	15	67012300	0.853	4M	0.513		67012312	0.927	4M	0.659	67012400	0.818	4S	0.701		
67012412	0.816	4S	0.642		67012500	0.825	4M	0.562		67012512	0.828	4M	0.755	67012600	0.882	4M	0.761		
67012612	0.951	4M	0.721		67012700	0.849	4M	0.633		67012712	0.651	UM	****	4	67012800	0.691	UM	****	22
67012812	0.900	16M	0.810	11	67012900	0.881	16M	0.767		67012912	0.849	16M	0.822	67013000	0.703	UM	****	24	
67013012	0.577	UM	****	24	67013100	0.585	UM	****	10	67013112	0.809	9M	0.732	67020100	0.705	UM	****	18	
67020112	0.804	9M	0.753		67020200	0.846	2S	0.811	23*	67020212	0.872	6S	0.854	67020300	0.935	6M	0.784		
67020312	0.823	19S	0.786		67020400	0.753	2M	0.549		67020412	0.775	UM	****	7	67020500	0.782	UM	****	8
67020512	0.830	17S	0.758		67020600	0.924	3M	0.549		67020612	0.807	1M	0.763	67020700	0.720	UM	****	19	
67020712	0.773	UM	****	7	67020800	0.809	2M	0.790		67020812	0.809	12M	0.701	67020900	0.873	7S	0.787		
67020912	0.908	7M	0.812	18	67021000	0.822	7M	0.811	18*	67021012	0.916	3M	0.640	67021100	0.861	17M	0.738		
67021112	0.711	US	****	8	67021200	0.935	10M	0.803	6	67021212	0.859	7M	0.790	67021300	0.832	7M	0.804	5*	
67021312	0.772	UM	****	5	67021400	0.784	UM	****	10	67021412	0.827	9M	0.816	67021500	0.930	9S	0.684		
67021512	0.897	9M	0.670		67021600	0.862	9M	0.780		67021612	0.605	UM	****	11	67021700	0.663	UM	****	2
67021712	0.913	5M	0.823	12	67021800	0.832	2M	0.819	2	67021812	0.803	8M	0.645	67021900	0.771	UM	****	2	
67021912	0.932	5M	0.871	2*	67022000	0.737	US	****	12	67022012	0.828	4M	0.696	67022100	0.735	UM	****	22	
67022112	0.744	US	****	1	67022200	0.499	UM	****	1	67022212	0.762	UM	****	2	67022300	0.899	5M	0.860	2*
67022312	0.963	5M	0.763		67022400	0.863	5M	0.633		67022412	0.572	UM	****	16	67022500	0.821	7M	0.767	
67022512	0.870	6M	0.783		67022600	0.863	6M	0.762		67022612	0.841	19M	0.751	67022700	0.882	2M	0.809	14	
67022712	0.914	2M	0.870	13*	67022800	0.944	11M	0.825	7	67022812	0.722	UM	****	20	67022900	0.952	6M	0.801	17
67120112	0.935	6M	0.795		67120200	0.936	19M	0.758		67120212	0.872	2M	0.786	67120300	0.935	2S	0.784		
67120312	0.922	2S	0.783		67120400	0.897	15S	0.812	20	67120412	1.000	15M	0.702	67120500	0.908	15M	0.760		
67120512	0.881	15M	0.726		67120600	0.865	15M	0.682		67120612	0.810	15M	0.788	67120700	0.736	UM	****	20	
67120712	0.614	UM	****	20	67120800	0.816	11M	0.722		67120812	0.847	2M	0.838	67120900	0.934	5M	0.810	13	
67120912	0.903	5M	0.862	13*	67121000	0.716	UM	****	13	67121012	0.634	UM	****	20	67121100	0.772	UM	****	3

67121112	0.943	1M	0.663	67121200	0.934	1M	0.590	67121212	0.878	1M	0.612	67121300	0.523	UM	****	1
67121312	0.802	8S	0.662	67121400	0.899	5S	0.799	67121412	0.846	5S	0.609	67121500	0.826	5M	0.592	
67121512	0.615	UM	****	67121600	0.601	UM	****	67121612	0.905	1M	0.761	67121700	0.857	1M	0.765	
67121712	0.534	19M	0.790	67121800	0.841	1M	0.772	67121812	0.810	1M	0.720	67121900	0.538	US	****	15
67121912	0.529	US	****	67122000	0.570	UM	****	67122012	0.589	UM	****	67122100	0.650	UM	****	1
67122112	0.659	UM	****	67122200	0.817	3M	0.758	67122212	0.919	4M	0.751	67122300	0.928	4S	0.810	8
67122312	0.829	3S	0.815	67122400	0.869	3S	0.752	67122412	0.850	3S	0.840	67122500	0.868	3M	0.792	
67122512	0.730	UM	****	67122600	0.755	UM	****	67122612	0.883	4M	0.591	67122700	0.839	5M	0.778	
67122712	0.493	UM	****	67122800	0.649	UM	****	67122812	0.773	UM	****	67122900	0.890	1S	0.869	4*
67122912	0.958	1M	0.800	67123000	0.734	US	****	67123012	0.935	8S	0.829	67123100	0.821	2S	0.787	
67123112	0.866	15M	0.731	68010100	0.570	UM	****	68010112	0.420	UM	****	68010200	0.763	UM	****	2
68010212	0.768	US	****	68010300	0.766	US	****	68010312	0.900	8S	0.779	68010400	0.846	2M	0.724	
68010412	0.700	US	****	68010500	0.595	UM	****	68010512	0.868	8M	0.550	68010600	0.654	UM	****	2
68010612	0.647	UM	****	68010700	0.846	4M	0.721	68010712	0.673	UM	****	68010800	0.645	UM	****	11
68010812	0.681	UM	****	68010900	0.469	UM	****	68010912	0.698	UM	****	68011000	0.885	15M	0.731	4
68011012	0.831	6M	0.769	68011100	0.857	23S	0.791	68011112	0.660	US	****	68011200	0.476	US	****	
68011212	0.576	UM	****	68011300	0.862	1M	0.683	68011312	0.591	UM	****	68011400	0.859	2M	0.731	
68011312	0.934	11M	0.766	68011500	0.646	UM	****	68011512	0.890	13M	0.697	68011600	0.878	13M	0.866	6*
68011612	0.780	UM	****	68011700	0.763	UM	****	68011712	0.839	1M	0.795	68011800	0.622	UM	****	18
68011812	0.865	21M	0.779	68011900	0.747	UM	****	68011912	0.675	UM	****	68012000	0.625	UM	****	23
68012012	0.477	UM	****	68012100	0.823	15M	0.652	68012112	0.742	UM	****	68012200	0.467	UM	****	1
68012212	0.809	14M	0.719	68012300	0.832	12S	0.846	68012312	0.871	6S	0.747	68012400	0.899	18M	0.938	5*
68012412	0.786	UM	****	68012500	0.819	19S	0.802	68012512	0.812	19S	0.784	68012600	0.763	US	****	15
68012612	0.733	US	****	68012700	0.904	5S	0.728	68012712	0.851	5M	0.728	68012800	0.628	US	****	8
68012812	0.804	16M	0.674	68012900	0.891	3M	0.779	68012912	0.756	UM	****	68013000	0.893	7M	0.766	24
68013012	0.935	16M	0.874	68013100	0.765	US	****	68013112	0.823	16M	0.696	68020100	0.731	UM	****	11
68020312	0.801	3M	0.645	68020400	0.660	UM	****	68020412	0.704	UM	****	68020500	0.835	1M	0.763	
68020512	0.758	UM	****	68020600	0.931	2M	0.750	68020612	0.969	2S	0.805	68020700	0.896	6S	0.504	23
68020712	1.000	18S	0.706	68020800	0.953	2S	0.747	68020812	0.826	5S	0.767	68020900	0.920	5M	0.685	
68020912	0.577	UM	****	68021000	0.540	UM	****	68021012	0.468	UM	****	68021100	0.736	UM	****	7
68021112	0.821	5M	0.692	68021200	0.691	US	****	68021212	0.304	UM	****	68021300	0.365	UM	****	2
68021312	0.434	UM	****	68021400	0.775	UM	****	68021412	0.832	1M	0.706	68021500	0.811	7M	0.782	
68021512	0.860	7S	0.787	68021600	0.795	US	****	68021612	0.832	24M	0.777	68021700	0.846	24M	0.728	
68021712	0.870	7M	0.774	68021800	0.899	7M	0.892	68021812	0.937	10M	0.811	68021900	0.904	10M	0.853	19
68021912	1.000	24M	0.670	68022000	0.790	US	****	68022012	0.891	14S	0.869	68022100	0.857	11S	0.850	20*
68022112	0.917	12M	0.812	68022200	0.840	12M	0.814	68022212	0.843	11M	0.833	68022300	0.859	14M	0.822	20*
68022312	0.689	UM	****	68022400	0.853	7M	0.823	68022412	0.931	6M	0.830	68022500	0.837	6M	0.764	
68022512	0.893	7M	0.755	68022600	0.926	6M	0.799	68022612	0.956	18M	0.575	68022700	0.876	8S	0.841	7*
68022712	0.936	5M	0.799	68022800	0.879	5M	0.667	68022812	0.695	UM	****	68022900	0.716	UM	****	12
68022912	0.549	UM	****	68120100	0.634	UM	****	68120112	0.568	UM	****	68123200	0.769	UM	****	13
68120312	0.833	11M	0.646	68120300	0.746	UM	****	68120312	0.910	13M	0.805	68120400	0.829	1M	0.784	
68120412	0.937	11M	0.836	68120500	0.746	UM	****	68120512	0.834	9M	0.741	68120600	0.773	UM	****	5
68120612	0.816	15M	0.803	68120700	0.863	9S	0.961	68120712	0.867	12S	0.769	68120800	0.674	UM	****	16
68120812	0.773	US	****	68120900	0.823	3M	0.770	68120912	0.841	22S	0.769	68121000	0.696	US	****	22
68121012	0.576	UM	****	68121100	0.678	US	****	68121112	0.877	8M	0.658	68121200	0.766	UM	****	2
68121212	0.808	5M	0.736	68121300	0.961	5S	0.796	68121312	0.978	5S	0.721	68121400	0.927	5M	0.755	
68121412	0.868	11M	0.791	68121500	0.830	2M	0.742	68121512	0.925	8M	0.838	68121600	0.870	5M	0.833	2*
68121612	0.873	5M	0.805	68121700	0.919	5M	0.842	68121712	0.951	5M	0.698	68121800	0.800	UM	****	8
68121812	0.866	16M	0.619	68121900	0.723	UM	****	68121912	0.774	UM	****	68122000	0.872	4M	0.539	
68122012	0.914	23M	0.738	68122100	0.838	1M	0.779	68122112	0.860	1M	0.798	68122200	0.831	23S	0.764	
68122212	0.588	UM	****	68122300	0.673	US	****	68122312	0.805	4M	0.723	68122400	0.855	4M	0.724	
68122412	0.821	4S	0.794	68122500	0.739	US	****	68122512	0.811	3M	0.770	68122600	0.922	1M	0.694	
68122612	0.943	1M	0.723	68122700	0.895	1M	0.793	68122712	0.926	23M	0.712	68122800	0.902	23M	0.729	
68122812	0.914	23M	0.738	68122900	0.829	23M	0.747	68122912	0.772	UM	****	68123000	0.660	UM	****	15
68123012	0.642	UM	****	68123100	0.709	UM	****	68123112	0.738	UM	****	69010100	0.775	UM	****	3
69010312	0.654	UM	****	69010400	0.588	UM	****	69010412	0.704	UM	****	69010300	0.852	12M	0.741	
69010512	0.883	9M	0.741	69010600	0.834	12S	0.825	69010612	0.831	6M	0.815	69010500	0.823	1M	0.762	
69010712	0.963	1M	0.704	69010800	0.833	1M	0.829	69010812	0.881	3M	0.711	69010700	0.830	3M	0.725	
69010912	0.840	3M	0.826	69011000	0.852	3M	0.850	69011012	0.840	1M	0.790	69010900	0.875	1M	0.746	

69010912	0.827	3M	0.794	23	69011000	0.798	UM	****	4	69011012	0.815	17M	0.761	69011100	0.804	22M	0.645
69011112	0.738	15M	0.773	23	69011200	0.819	15M	0.691	4	69011212	0.836	6M	0.800	69011300	0.869	6M	0.809
69011312	0.912	15M	0.773	23	69011400	0.830	15M	0.715	3	69011412	0.797	UM	****	69011500	0.810	19M	0.782
69011512	0.821	23M	0.708	23	69011600	0.772	UM	****	3	69011612	0.809	1M	0.645	69011700	0.881	1M	0.673
69011712	0.802	3M	0.794	23	69011800	0.841	3M	0.750	4	69011812	0.858	3M	0.821	69011900	0.847	3M	0.738
69011912	0.823	3M	0.794	23	69012000	0.731	UM	****	4	69012012	0.766	UM	****	69012100	0.693	UM	****
69012112	0.864	4M	0.672	23	69012200	0.830	4M	0.653	15	69012212	0.803	4M	0.636	69012300	0.829	4M	0.574
69012312	0.633	UM	****	1	69012400	0.623	UM	****	15	69012412	0.855	23M	0.753	69012500	0.676	US	****
69012512	0.623	UM	****	2	69012600	0.700	UM	****	12	69012612	0.842	4M	0.769	69012700	0.871	4M	0.787
69012712	0.809	4M	0.583	2	69012800	0.609	UM	****	1	69012812	0.675	UM	****	69012900	0.460	UM	****
69012912	0.529	UM	****	2	69013000	0.919	8M	0.736	1	69013012	0.919	8M	0.800	69013100	0.965	2S	****
69013112	0.972	2S	0.775	2	69013200	0.920	2S	0.788	13	69013212	0.931	2M	0.758	69013200	0.954	2M	0.718
69013212	0.912	2S	0.827	10	69013300	0.850	2S	0.821	13	69013312	0.931	21M	0.697	69020400	0.745	UM	****
69020412	0.792	UM	****	13	69020500	0.870	21S	0.808	23	69020512	0.904	13M	0.737	69020600	0.756	UM	****
69020612	0.504	UM	****	19	69020700	0.772	UM	****	10	69020712	0.852	9M	0.735	69020800	0.923	9S	0.664
69020912	0.908	9S	0.755	14	69020900	0.859	15S	0.853	5	69020912	0.908	6M	0.784	69021000	0.838	6M	0.677
69021012	0.547	UM	****	14	69021100	0.878	2M	0.850	9	69021112	0.882	2M	0.857	69021200	0.956	2S	0.789
69021212	0.909	11M	0.852	7	69021300	0.716	UM	****	13	69021312	0.709	UM	****	69021400	0.872	16M	0.705
69021412	0.822	13M	0.693	7	69021500	0.821	1M	0.698	13	69021512	0.933	1M	0.703	69021600	0.743	UM	****
69021512	0.828	14M	0.780	2	69021600	0.919	11M	0.707	7	69021612	0.830	5M	0.639	69021800	0.824	8M	0.808
69021612	0.893	2M	0.890	2	69021700	0.834	5M	0.801	7	69021712	0.875	2M	0.795	69022000	0.792	UM	****
69022012	0.597	UM	****	9	69021800	0.890	2M	0.774	10	69021812	0.875	2M	0.795	69022200	0.930	5M	0.721
69022212	0.787	UM	****	8	69022300	0.690	UM	****	10	69022312	0.893	2M	0.771	69022400	0.914	2M	0.773
69022412	0.837	11M	0.809	12	69022500	0.818	5M	0.774	2	69022512	0.930	5M	0.723	69022600	0.952	5M	0.710
69022612	0.899	5M	0.674	14	69022700	0.933	5M	0.832	2	69022712	0.931	5M	0.609	69022800	0.700	UM	****
69022812	0.713	UM	****	2	69120100	0.751	UM	****	9	69120112	0.746	US	****	69120200	0.812	3M	0.630
69120212	0.657	UM	****	2	69120300	0.952	2M	0.841	9	69120312	0.864	2M	0.835	69120400	0.880	12M	0.610
69120412	0.777	UM	****	17	69120500	0.863	19M	0.836	15	69120512	0.805	18M	0.751	69120600	0.791	US	****
69120612	0.891	8S	0.826	12	69120700	0.933	5S	0.788	7	69120712	0.966	5S	0.791	69120800	0.941	5M	0.771
69120812	0.875	5M	0.852	9	69120900	0.908	14M	0.706	7	69120912	0.802	14M	0.780	69121000	0.820	2M	0.710
69121012	0.751	UM	****	7	69121100	0.695	UM	****	7	69121112	0.834	2M	0.760	69121200	0.878	2M	0.821
69121212	0.827	12M	0.817	7	69121300	0.908	2M	0.811	13	69121312	0.848	11M	0.833	69121400	0.902	11M	0.881
69121412	0.856	11S	0.840	20	69121500	0.914	12M	0.716	1	69121512	0.435	UM	****	69121600	0.696	UM	****
69121512	0.791	UM	****	1	69121700	0.799	UM	****	1	69121712	0.846	4M	0.668	69121800	0.912	4M	0.578
69121812	0.784	UM	****	12	69121900	0.890	8M	0.727	13	69121912	0.806	8M	0.727	69122000	0.593	UM	****
69122012	0.698	UM	****	13	69122100	0.830	11M	0.775	4	69122112	0.772	UM	****	69122200	0.849	15M	0.738
69122212	0.825	15M	0.807	20	69122300	0.900	12M	0.729	19	69122312	0.814	6S	0.737	69122400	0.918	6M	0.688
69122412	0.829	6M	0.658	3	69122500	0.799	UM	****	4	69122512	0.858	24M	0.544	69122600	0.819	7M	0.705
69122612	0.880	10M	0.844	3	69122700	0.799	UM	****	7	69122712	0.600	UM	****	69122800	0.891	8M	0.849
69122812	0.908	8M	0.857	12	69122900	0.926	11M	0.867	7	69122912	0.724	UM	****	69123000	0.726	UM	****
69123012	0.928	8M	0.847	12	69123100	0.805	5M	0.661	12	69123112	0.676	UM	****	70010100	0.872	5M	0.858
70010112	0.926	5M	0.836	2	70010200	0.709	UM	****	12	70010212	0.716	UM	****	70010300	0.667	UM	****
70010312	0.754	UM	****	22	70010400	0.884	1M	0.674	9	70010412	0.951	1M	0.672	70010500	0.940	1M	0.674
70010512	0.909	1M	0.713	2	70010600	0.906	1M	0.775	19	70010612	0.796	UM	****	70010700	0.747	UM	****
70010712	0.936	2M	0.711	2	70010800	0.917	2M	0.775	4	70010812	0.859	2M	0.796	70010900	0.879	9M	0.704
70010912	0.891	7M	0.796	2	70011000	0.883	13S	0.782	7	70011012	0.815	1S	0.731	70011100	0.900	1S	0.668
70011112	0.921	1M	0.688	4	70011200	0.911	1M	0.778	7	70011212	0.880	1M	0.606	70011300	0.848	1M	0.744
70011312	0.840	1M	0.672	4	70011400	0.830	1M	0.684	8	70011412	0.950	1M	0.730	70011500	0.940	1M	0.748
70011512	0.855	1M	0.850	4	70011600	0.884	3M	0.677	8	70011612	0.861	4M	0.827	70011700	0.816	4M	0.747
70011712	0.608	UM	****	2	70011800	0.905	2M	0.828	19	70011812	0.885	2M	0.764	70011900	0.788	UM	****
70011912	0.833	2M	0.777	18	70012000	0.921	2M	0.768	3	70012012	0.908	2M	0.776	70012100	0.858	18M	0.920
70012112	0.876	18M	0.782	18	70012200	0.867	2M	0.745	3	70012212	0.846	9M	0.776	70012300	0.775	UM	****
70012312	0.973	7M	0.855	18	70012400	0.948	10M	0.682	8	70012412	0.861	10M	0.767	70012500	0.793	UM	****
70012512	0.879	3M	0.736	18	70012600	0.772	UM	****	8	70012612	0.783	UM	****	70012700	0.944	10M	0.804
70012712	0.841	10M	0.759	18	70012800	0.796	UM	****	19	70012812	0.780	UM	****	70012900	0.855	17M	0.597
70012912	0.833	3M	0.610	6	70013000	0.893	10M	0.843	3	70013012	0.845	7M	0.813	70013100	0.879	10S	0.706
70013112	0.840	10M	0.823	6	70020100	0.899	10S	0.888	6	70020112	0.854	10S	0.852	70020200	0.922	20S	0.732
70020212	0.874	24S	0.809	21	70020300	0.789	UM	****	10	70020312	0.796	US	****	70020400	0.936	6M	0.705
70020412	0.840	6M	0.735	9	70020500	0.776	UM	****	10	70020512	0.826	14M	0.743	70020600	0.780	UM	****
70020612	0.790	UM	****	9	70020700	0.625	UM	****	20	70020712	0.650	UM	****	70020800	0.820	2M	0.746

70020812	0.749	UM	*****	7	70020900	0.336	19M	0.714	6	70020912	0.881	19M	0.799	5	70021000	0.695	UM	*****	11
70021012	0.845	7M	0.747	7M	70021100	0.877	6M	0.824	6	70021112	0.788	UM	*****	5	70021200	0.770	UM	*****	7
70021212	0.858	2M	0.811	2*	70021300	0.826	2M	0.764	19	70021312	0.817	6M	0.693	10	70021400	0.808	6M	0.754	5
70021412	0.810	24M	0.674	18	70021500	0.787	UM	*****	10	70021512	0.806	9S	0.717	2	70021600	0.720	US	*****	19
70021612	0.750	US	*****	12	70021700	0.729	UM	*****	19	70021712	0.675	UM	*****	10	70021800	0.732	UM	*****	2
70021812	0.811	20M	0.753	12	70021900	0.694	UM	*****	20	70021912	0.695	UM	*****	5*	70022000	0.763	UM	*****	1
70022012	0.752	UM	*****	9	70022100	0.311	UM	0.702	13	70022112	0.894	1M	0.688	1	70022200	0.808	20M	0.734	2*
70022212	0.892	2M	0.640	12	70022300	0.956	6M	0.820	13	70022312	0.894	1M	0.658	1	70022400	0.816	2M	0.803	1
70022412	0.931	8S	0.837	12	70022500	0.892	5M	0.820	13	70022512	0.853	18M	0.935	1	70022600	0.627	UM	*****	7
70022612	0.828	1M	0.684	7	70022700	0.943	1M	0.647	13	70022712	0.944	1M	0.658	1	70022800	0.814	1M	0.713	1
70022812	0.705	UM	*****	7	70022900	0.892	5M	0.647	13	70022912	0.944	1M	0.658	1	70023000	0.918	16M	0.732	1
70023012	0.945	16M	0.725	7	70023100	0.839	16M	0.647	13	70023112	0.922	16M	0.749	1	70023200	0.853	13M	0.792	1
70023212	0.913	16M	0.678	7	70023300	0.966	22M	0.687	13	70023312	1.000	22M	0.672	12	70023400	0.738	UM	*****	7
70023412	0.865	6M	0.618	23*	70023500	0.931	4M	0.720	13	70023512	0.789	UM	*****	12	70023600	0.767	UM	*****	5
70023612	0.865	6M	0.618	23*	70023700	0.995	6M	0.775	13	70023712	0.789	UM	*****	12	70023800	0.767	UM	*****	5
70023812	0.706	UM	*****	10	70023900	0.748	UM	*****	10	70023912	0.939	6M	0.701	10	70024000	0.808	20M	0.734	2*
70024012	0.859	2M	0.828	10*	70024100	0.942	2M	0.777	10	70024112	0.622	UM	*****	10	70024200	0.767	UM	*****	1
70024212	0.877	11M	0.872	7*	70024300	0.847	11M	0.841	7	70024312	0.870	15S	0.846	5*	70024400	0.886	15M	0.695	19
70024412	0.833	12M	0.807	9*	70024500	0.900	12M	0.637	7	70024512	0.910	11M	0.816	7	70024600	0.877	11M	0.822	9
70024612	0.825	1M	0.797	9*	70024700	0.825	7M	0.769	7	70024712	0.733	UM	*****	20	70024800	0.853	7M	0.732	3*
70024812	0.647	UM	*****	4	70024900	0.632	5M	0.630	1	70024912	0.824	10M	0.805	3*	70025000	0.833	10M	0.827	3*
70025012	0.734	US	*****	2	70025100	0.902	5M	0.630	1	70025112	0.771	UM	*****	2	70025200	0.600	UM	*****	2
70025212	0.781	UM	*****	2	70025300	0.955	UM	*****	2	70025312	0.680	UM	*****	15	70025400	0.785	UM	*****	14
70025412	0.914	8S	0.817	7	70025500	0.815	2S	0.796	13*	70025512	0.724	UM	*****	15	70025600	0.541	UM	*****	14
70025612	0.875	11S	0.803	12	70025700	0.839	12S	0.648	13*	70025712	0.430	US	*****	15	70025800	0.729	UM	*****	12
70025812	0.949	7M	0.746	7	70025900	0.790	UM	*****	6	70025912	0.936	12M	0.821	16	70026000	0.735	UM	*****	20
70026012	0.906	2M	0.786	7	70026100	0.974	15M	0.773	4*	70026112	0.854	6M	0.821	23*	70026200	0.837	2M	0.809	14*
70026212	0.715	UM	*****	3	70026200	0.974	15M	0.773	4*	70026212	0.854	6M	0.821	23*	70026300	0.771	UM	*****	15
70026412	0.677	UM	*****	2	70026300	0.878	8M	0.555	12*	70026312	0.903	5M	0.666	8	70026400	0.811	1M	0.700	11
70026612	0.861	5M	0.815	2*	70026400	0.944	5M	0.555	12*	70026412	0.903	5M	0.666	8	70026500	0.918	5M	0.705	11
70026812	0.871	16S	0.792	4	70026500	0.853	16S	0.684	4*	70026512	0.550	UM	*****	8	70026600	0.703	UM	*****	11
70027012	0.894	1S	0.838	4	70026600	0.879	1S	0.568	4*	70026612	0.819	1S	0.727	8	70026700	0.910	1S	0.830	18
70027212	0.894	4S	0.753	4	70026700	0.899	4S	0.826	4	70026712	0.905	3S	0.798	3	70026800	0.879	4S	0.817	4
70027412	0.923	1M	0.662	7	70026800	0.961	1M	0.696	4	70026812	0.886	3S	0.778	4	70026900	0.652	UM	*****	6
70027612	0.715	UM	*****	7	70026900	0.833	15S	0.630	4	70026912	0.951	1M	0.639	4	70027000	0.712	UM	*****	14
70027812	0.742	UM	*****	17	70027000	0.765	UM	*****	7	70027012	0.853	6S	0.804	23*	70027100	0.870	13M	0.747	17
70028012	0.365	US	*****	20	70027100	0.632	US	*****	3	70027112	0.967	2S	0.674	3	70027200	0.771	UM	*****	10
70028212	0.914	1S	0.646	22*	70027200	0.919	1M	0.619	3	70027212	0.757	US	*****	3	70027300	0.840	1M	0.771	10
70028412	0.844	1M	0.624	22*	70027300	0.847	16M	0.736	3	70027312	0.941	1M	0.676	3	70027400	0.899	1M	0.825	18*
70028612	0.932	16M	0.634	22	70027400	0.841	4M	0.740	3	70027412	0.800	17M	0.782	3	70027500	0.859	7M	0.742	2
70028812	0.786	UM	*****	3	70027500	0.748	UM	*****	10	70027512	0.630	UM	*****	8	70027600	0.751	UM	*****	9
70029012	0.799	UM	*****	3	70027600	0.772	US	*****	10	70027612	0.648	UM	*****	10	70027700	0.870	13M	0.747	17
70029212	0.675	1M	0.748	10	70027700	0.893	20M	0.789	10	70027712	0.816	3M	0.771	10	70027800	0.840	1M	0.771	10
70029412	0.844	1M	0.779	10	70027800	0.799	UM	*****	18	70027812	0.788	UM	*****	10	70027900	0.798	UM	*****	10
70029612	0.858	8M	0.808	7	70027900	0.841	1M	0.814	15*	70027912	0.800	UM	*****	18	70028000	0.859	7M	0.825	18*
70029812	0.483	UM	*****	20	70028000	0.831	5M	0.792	15*	70028012	0.617	UM	*****	15	70028100	0.766	UM	*****	2
70030012	0.868	6M	0.765	20	70028100	0.312	7M	0.772	15*	70028112	0.493	UM	*****	23	70028200	0.828	6M	0.742	9
70030212	0.939	14M	0.844	10	70028200	0.827	7M	0.717	15*	70028212	0.663	UM	*****	5	70028300	0.930	14M	0.720	17
70030412	0.832	9S	0.815	23*	70028300	0.890	6M	0.689	23*	70028312	0.789	UM	*****	5	70028400	0.845	6M	0.709	17
70030612	0.935	6M	0.849	14	70028400	0.371	6S	0.659	23*	70028412	0.975	6S	0.736	11*	70028500	0.870	11M	0.816	17
70030812	0.816	14M	0.815	7*	70028500	0.829	18M	0.502	5*	70028512	0.877	2M	0.856	11*	70028600	0.971	6S	0.816	17
70031012	0.633	UM	*****	2	70028600	0.895	2M	0.736	14*	70028612	0.877	2M	0.856	11*	70028700	0.870	11M	0.811	12
70031212	0.831	18M	0.759	2	70028700	0.910	2M	0.740	14*	70028712	0.898	5M	0.730	11*	70028800	0.700	UM	*****	12
70031412	0.822	13M	0.759	6*	70028800	0.329	2M	0.817	14*	70028812	0.918	2M	0.750	11*	70028900	0.789	UM	*****	7
70031612	0.956	1M	0.714	6*	70028900	0.329	1M	0.737	14*	70028912	0.827	2M	0.810	20*	70029000	0.814	21M	0.810	20*
70031812	0.861	4M	0.590	23*	70029000	0.846	1M	0.710	14*	70029012	0.949	1M	0.701	20*	70029100	0.960	1M	0.729	4
70032012	0.843	6S	0.831	23*	70029100	0.863	7M	0.713	14*	70029112	0.906	7M	0.669	3	70029200	0.733	UM	*****	4
70032212	0.784	US	*****	4	70029200	0.834	6M	0.713	14*	70029212	0.643	UM	*****	6	70029300	0.802	9M	0.797	4
70032412	0.599	UM	*****	1	70029300	0.691	10M	0.748	8	70029312	0.691	10M	0.850	6	70029400	0.695	US	*****	18
70032612	0.839	12S	0.834	7*	70029400	0.779	UM	*****	8	70029412	0.692	UM	*****	9	70029500	0.779	UM	*****	18
70032812	0.839	12S	0.834	7*	70029500	0.818	6S	0.783	8	70029512	0.857	7S	0.829	11*	70029600	0.948	2M	0.816	9
70033012	0.839	12S	0.834	7*	70029600	0.818	6S	0.783	8	70029612	0.857	7S	0.829	11*	70029700	0.798	US	*****	6

APPENDIX 3

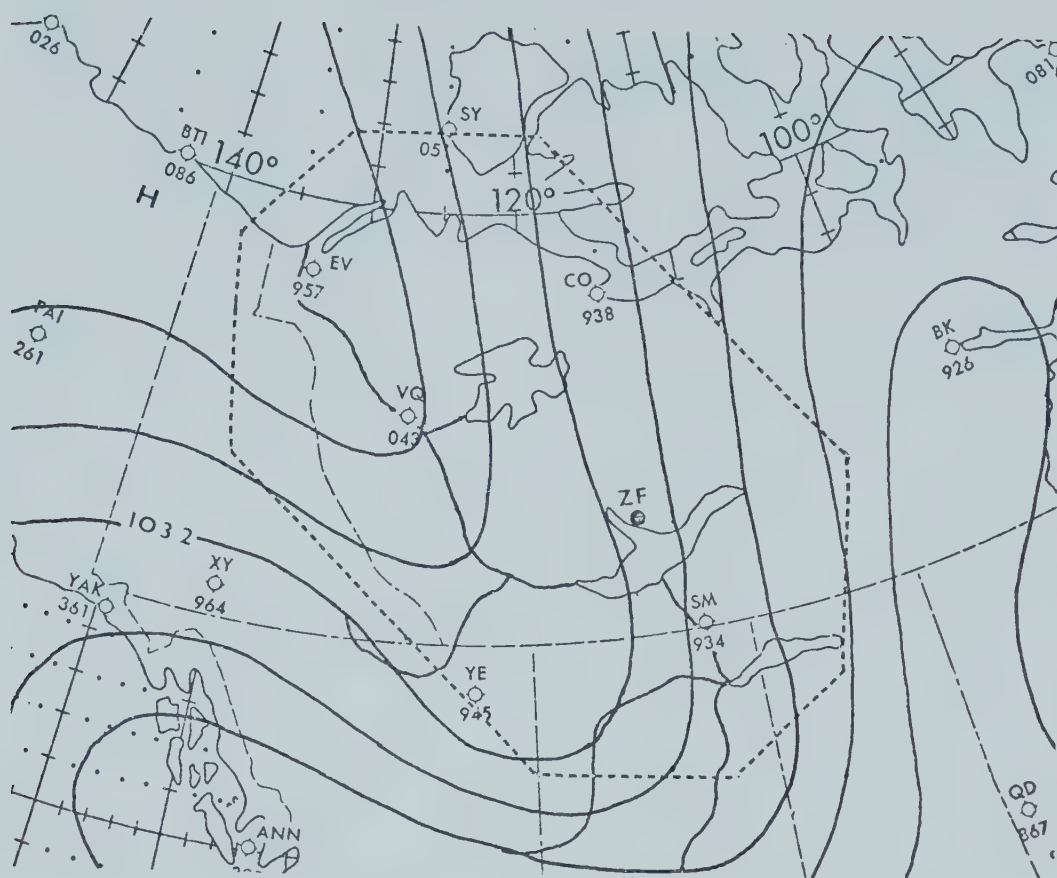
SURFACE MAP TYPES AND CHARACTERISTICS

At the top of each page is an illustration of the isobaric configuration of the key map for a type. The dashed lines form the boundaries of the Mackenzie window. One isobar is labelled and the isobars are drawn at intervals of four millibars.

The characteristics of all maps within a type are summarized by season and month. The months of January and February in 1946, and December, 1972 were not used in the determination of seasonal characteristics. The number of times the map pattern occurred during each period over the 27 years (1946-1972) is listed along with the percentage frequency relative to each period. This is followed by the average of the correlation coefficients resulting from the correlation between the key map and all maps assigned to the type. The mean map pressures listed have been subtracted from 1000 mb. The pressure gradient values are given in units of mb/grid interval (381 km).

Following the gradient information is a list of the types which most frequently follow the given type and the corresponding percentage. Finally, the duration of the map type is indicated by the number of 12-hour periods that the type persisted, and the corresponding percentage.

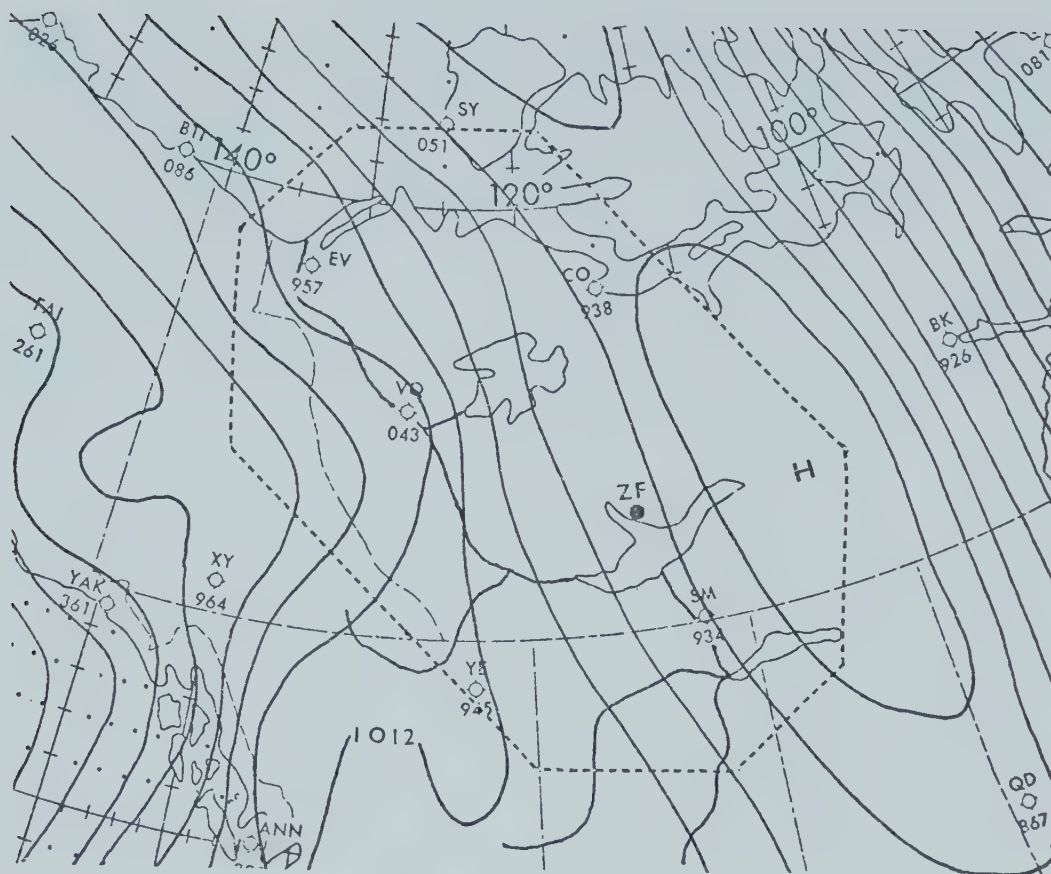
SURFACE MAP TYPE 1



KEY DATE - 12Z, 25 FEB 55

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	343/ 9	94/ 7	167/ 13	92/ 8
MEAN CORRELATION	0.881	0.879	0.881	0.883
MEAN PRESSURE (MSL)	24.42	24.95	25.01	22.83
MEAN PRESSURE GRADIENT	6.01	5.79	6.43	5.49
MEAN MAXIMUM GRADIENT	9.13	8.69	9.85	8.29
MEAN MINIMUM GRADIENT	2.78	2.73	3.00	2.42
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	1/ 51 U/ 21 3/ 14 10/ 4 4/ 2	1/ 51 U/ 21 3/ 15 7/ 3 23/ 3	1/ 57 U/ 17 3/ 16 10/ 4 20/ 3	1/ 46 U/ 30 3/ 10 10/ 5 4/ 3
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 47 2/ 29 3/ 13 4/ 6	2/ 40 1/ 34 3/ 23 8/ 3	1/ 48 2/ 27 3/ 8 4/ 6	1/ 65 2/ 16 3/ 10 4/ 6

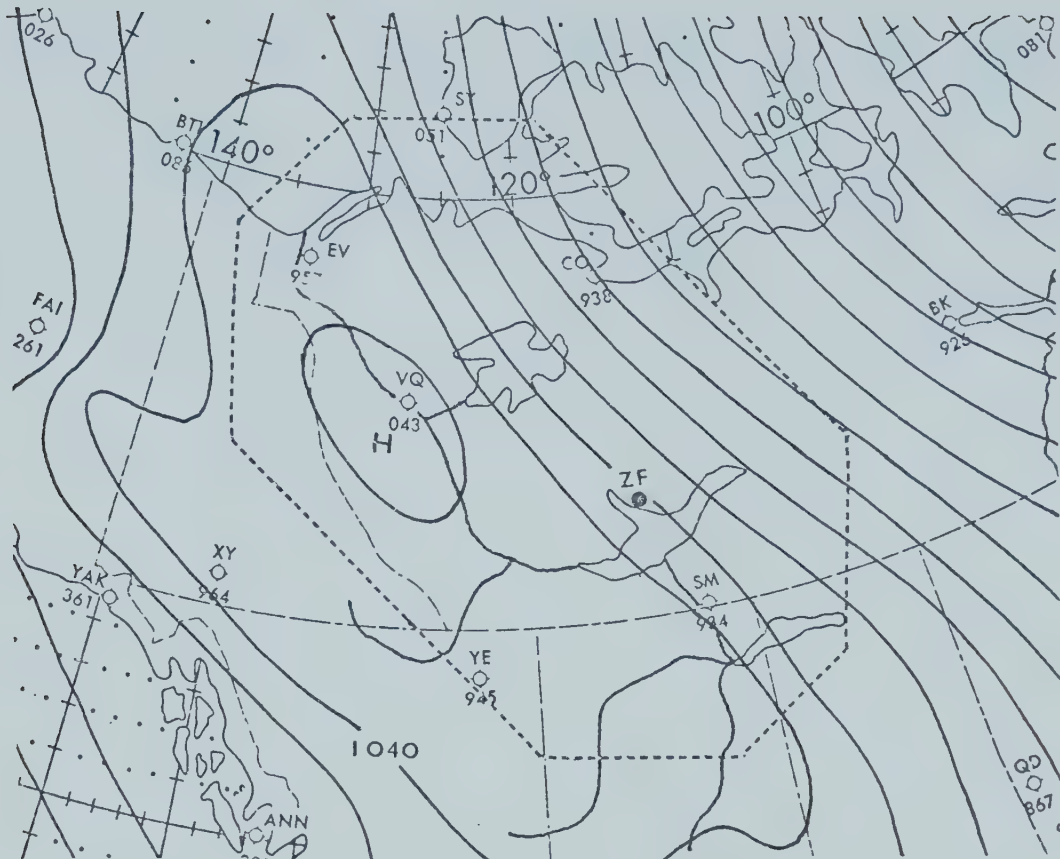
SURFACE MAP TYPE 2



KEY DATE - 12Z, 13 DEC 62

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	253/ 7	97/ 7	72/ 6	93/ 8
MEAN CORRELATION	0.891	0.889	0.897	0.887
MEAN PRESSURE (MSL)	18.30	14.90	19.82	20.68
MEAN PRESSURE GRADIENT	5.89	5.88	6.37	5.52
MEAN MAXIMUM GRADIENT	8.71	8.67	9.42	8.21
MEAN MINIMUM GRADIENT	3.18	3.18	3.42	3.00
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	2/ 42 U/ 12 11/ 11 12/ 9 6/ 6	2/ 42 U/ 14 11/ 13 12/ 9 15/ 6	2/ 47 U/ 17 12/ 11 11/ 8 6/ 6	2/ 34 11/ 13 U/ 10 6/ 9 15/ 7
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 54 2/ 30 3/ 9 4/ 5	1/ 54 2/ 35 4/ 5 3/ 3	1/ 42 2/ 27 3/ 23 4/ 8	1/ 64 2/ 26 3/ 7 4/ 2

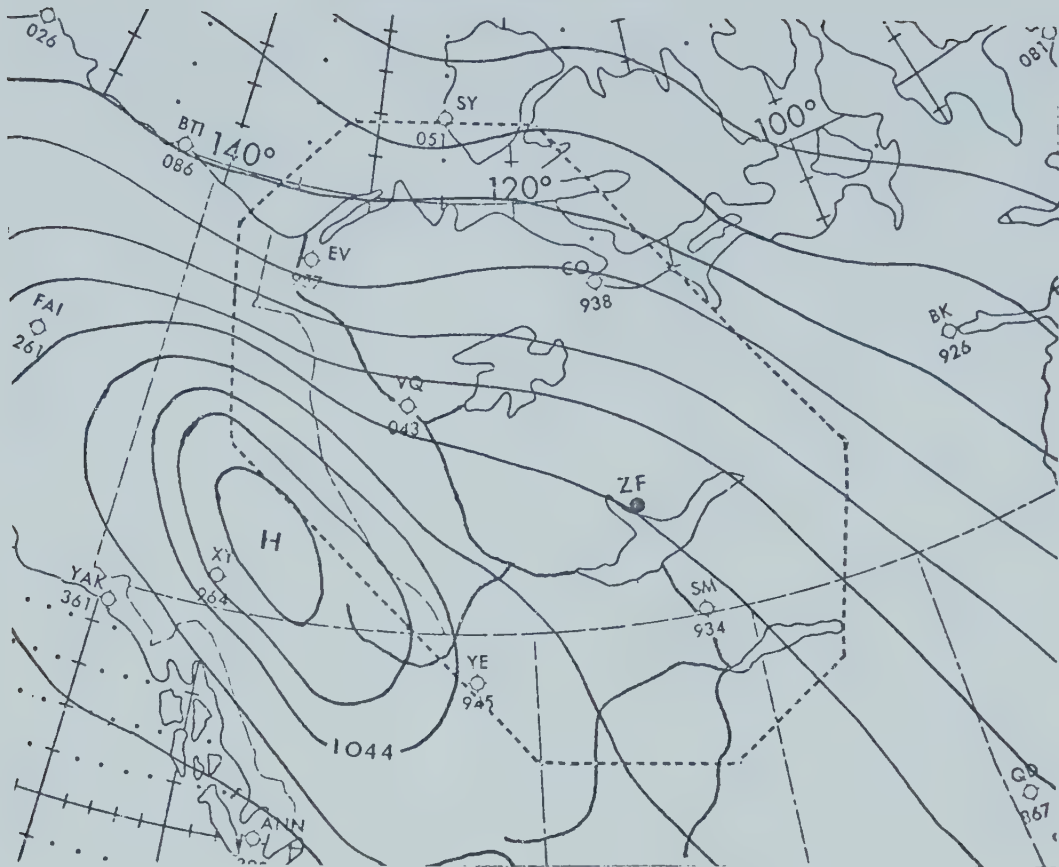
SURFACE MAP TYPE 3



KEY DATE - 12Z, 22 DEC 62

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	197/ 5	63/ 5	102/ 8	39/ 3
MEAN CORRELATION	0.873	0.861	0.876	0.886
MEAN PRESSURE (MSL)	25.28	25.71	25.80	23.26
MEAN PRESSURE GRADIENT	6.61	7.05	6.64	5.85
MEAN MAXIMUM GRADIENT	9.88	10.39	9.93	8.94
MEAN MINIMUM GRADIENT	3.22	3.26	3.31	2.95
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	3/ 47 U/ 20 1/ 18 4/ 7 17/ 3	3/ 52 U/ 21 4/ 8 1/ 8 16/ 4	3/ 53 1/ 20 U/ 15 4/ 8 17/ 1	1/ 30 3/ 26 U/ 26 17/ 11 4/ 4
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 56 2/ 18 3/ 12 4/ 9	1/ 50 3/ 23 4/ 14 2/ 9	1/ 49 2/ 20 3/ 11 4/ 11	1/ 70 2/ 25 3/ 5

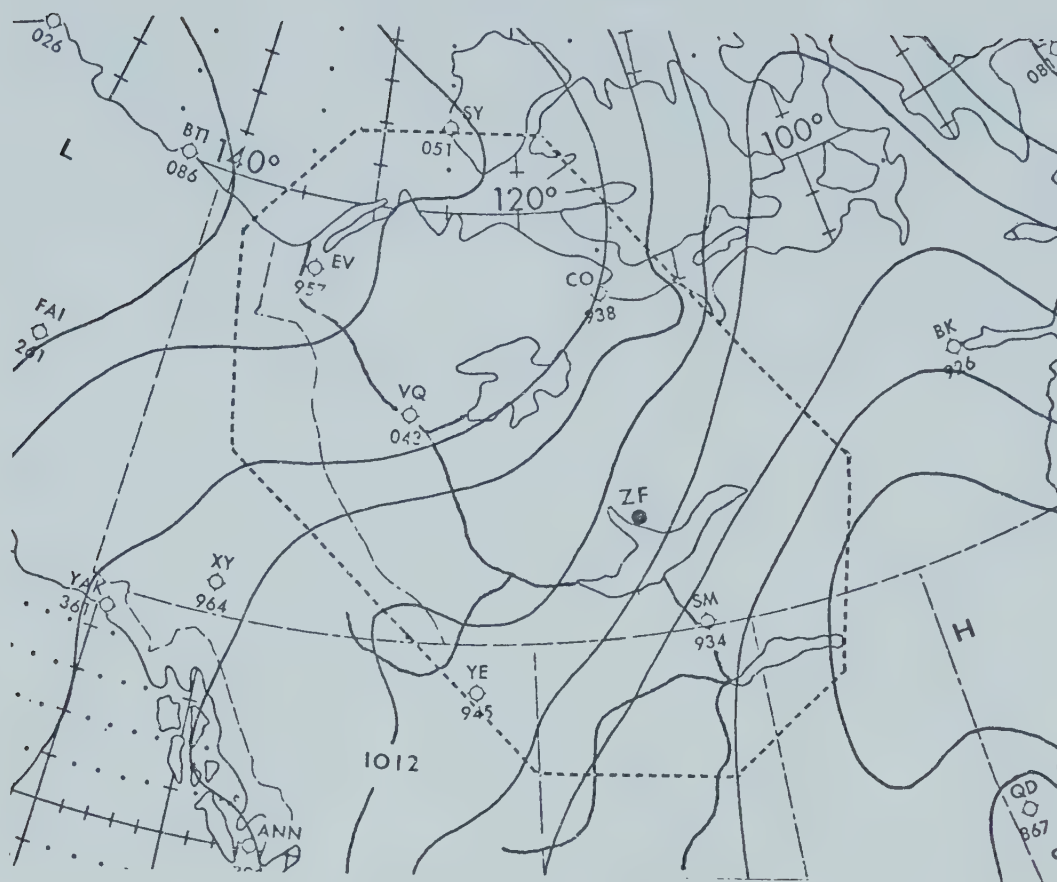
SURFACE MAP TYPE 4



KEY DATE - 12Z, 24 JAN 57

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	190/ 5	69/ 5	98/ 8	35/ 3
MEAN CORRELATION	0.874	0.878	0.871	0.876
MEAN PRESSURE (MSL)	24.63	23.89	25.81	22.78
MEAN PRESSURE GRADIENT	6.07	6.03	6.04	6.24
MEAN MAXIMUM GRADIENT	9.89	10.07	9.72	10.00
MEAN MINIMUM GRADIENT	2.72	2.64	2.76	2.77
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	4/ 49 U/ 29 3/ 9 17/ 6 5/ 6	4/ 44 U/ 32 5/ 9 3/ 5 17/ 4	4/ 54 U/ 29 3/ 7 17/ 6 5/ 3	4/ 45 U/ 25 3/ 20 17/ 5 5/ 5
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 48 2/ 28 3/ 16 5/ 3	1/ 48 2/ 34 3/ 10 4/ 3	1/ 52 2/ 19 3/ 19 4/ 3	1/ 44 2/ 33 3/ 22

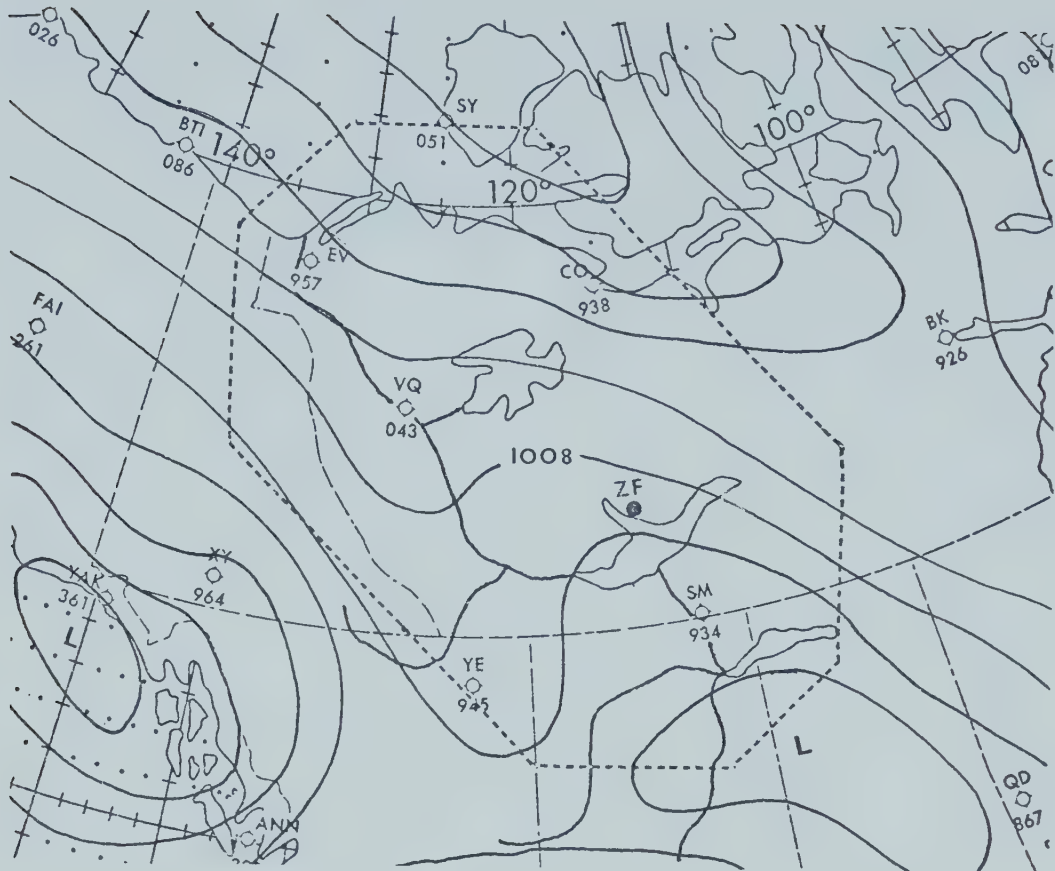
SURFACE MAP TYPE 5



KEY DATE - 12Z, 22 DEC 59

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	188/ 5	83/ 6	55/ 4	51/ 4
MEAN CORRELATION	0.883	0.882	0.888	0.882
MEAN PRESSURE (MSL)	15.39	12.69	19.89	14.94
MEAN PRESSURE GRADIENT	5.20	5.29	5.50	4.73
MEAN MAXIMUM GRADIENT	8.21	8.40	8.22	7.87
MEAN MINIMUM GRADIENT	2.45	2.50	2.93	1.84
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	5/ 45 U/ 33 14/ 6 2/ 4 11/ 4	5/ 49 U/ 28 2/ 6 11/ 6 14/ 5	5/ 36 U/ 30 14/ 12 17/ 6 11/ 6	5/ 48 U/ 45 14/ 5 7/ 2
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 58 2/ 18 3/ 10 4/ 9	1/ 56 3/ 16 4/ 16 2/ 9	1/ 70 2/ 20 4/ 5 5/ 5	1/ 48 2/ 29 3/ 14 4/ 5

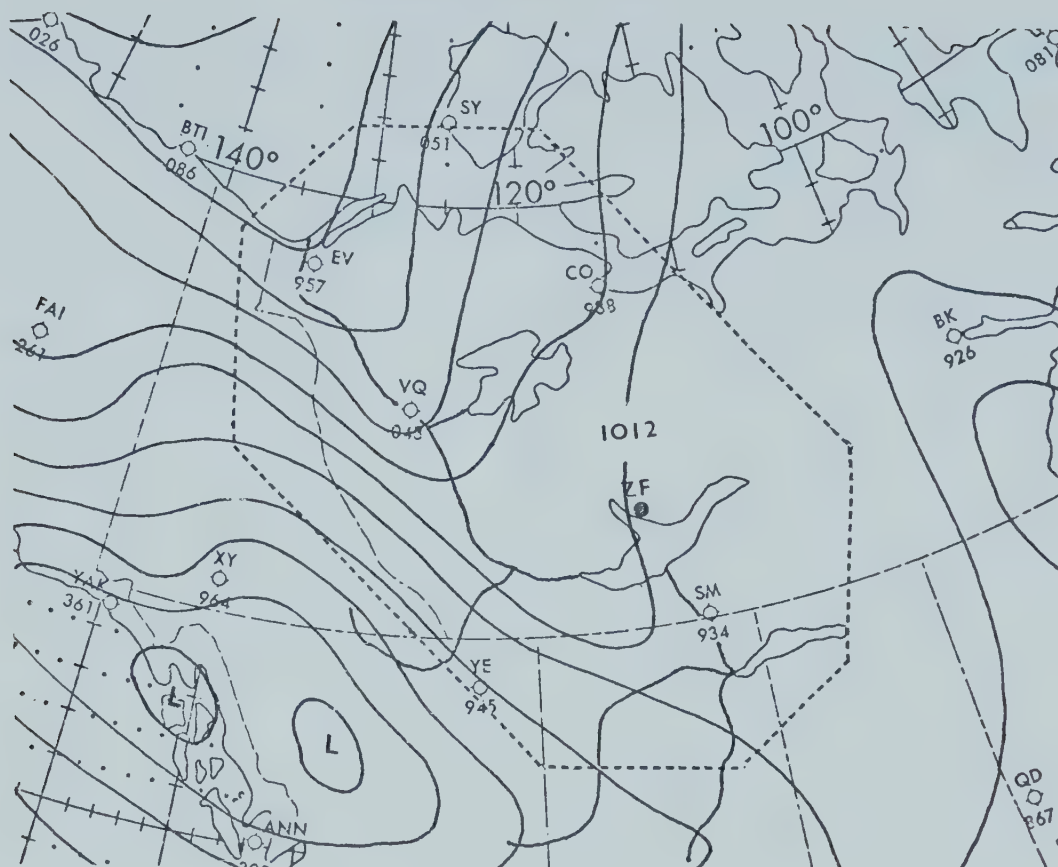
SURFACE MAP TYPE 6



KEY DATE - 12Z, 16 DEC 62

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	169/ 5	69/ 5	48/ 4	69/ 6
MEAN CORRELATION	0.877	0.880	0.867	0.881
MEAN PRESSURE (MSL)	15.22	12.10	15.34	18.27
MEAN PRESSURE GRADIENT	5.29	5.25	5.29	5.32
MEAN MAXIMUM GRADIENT	8.08	7.87	7.96	8.38
MEAN MINIMUM GRADIENT	2.55	2.66	2.46	2.49
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	6/ 38 U/ 19 7/ 9 18/ 8 19/ 7	6/ 53 U/ 16 2/ 8 19/ 8 18/ 6	U/ 28 7/ 20 6/ 16 15/ 12 2/ 8	6/ 40 U/ 17 18/ 13 7/ 10 19/ 6
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 59 2/ 28 3/ 8 4/ 3	1/ 38 3/ 29 2/ 24 4/ 5	1/ 81 2/ 19	1/ 52 2/ 38 4/ 7 3/ 3

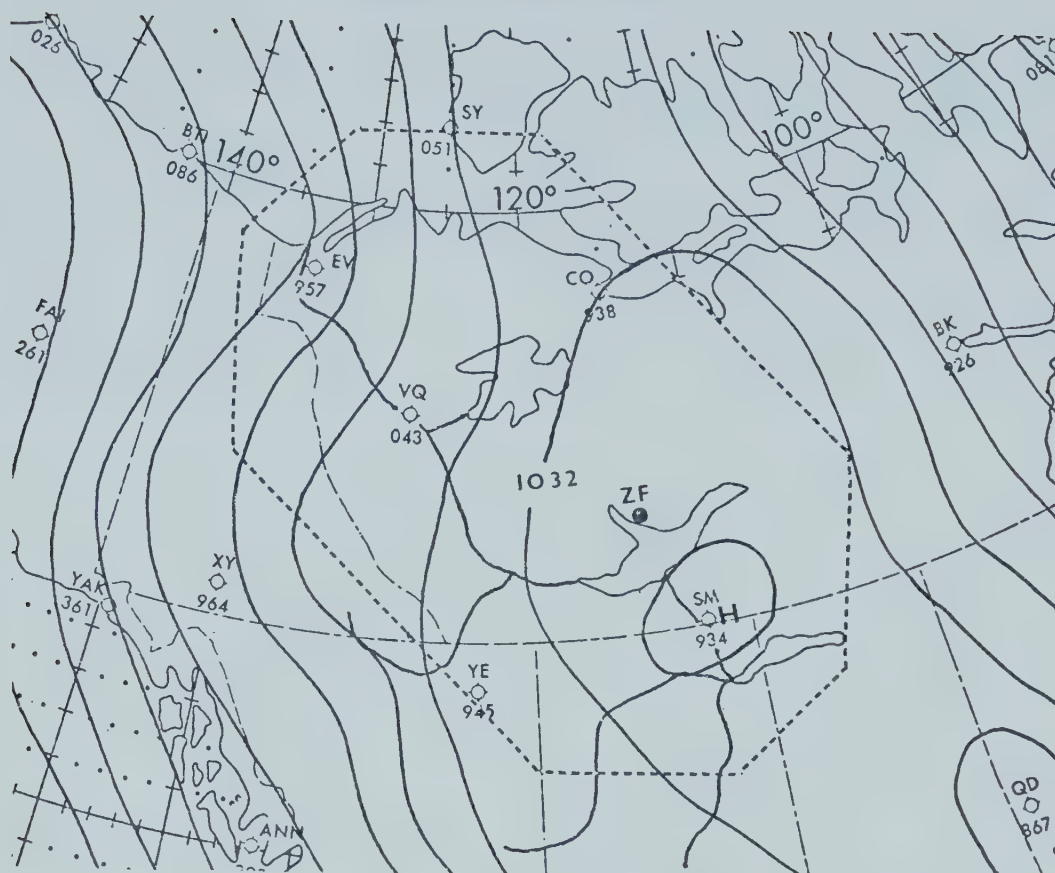
SURFACE MAP TYPE 7



KEY DATE - 12Z, 3 DEC 60

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	154/ 4	34/ 3	56/ 4	66/ 6
MEAN CORRELATION	0.867	0.868	0.867	0.867
MEAN PRESSURE (MSL)	18.79	16.41	17.77	20.87
MEAN PRESSURE GRADIENT	4.81	4.52	5.00	4.80
MEAN MAXIMUM GRADIENT	7.23	6.97	7.49	7.14
MEAN MINIMUM GRADIENT	2.17	1.97	2.17	2.28
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	7/ 33 U/ 18 10/ 16 1/ 14 .6/ 8	U/ 37 10/ 21 1/ 11 6/ 11 7/ 11	7/ 37 1/ 17 U/ 17 13/ 14 10/ 9	7/ 35 10/ 19 U/ 17 1/ 12 6/ 12
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 60 2/ 33 3/ 6 4/ 1	1/ 92 2/ 8	1/ 53 2/ 42 3/ 5	1/ 55 2/ 35 3/ 6 4/ 3

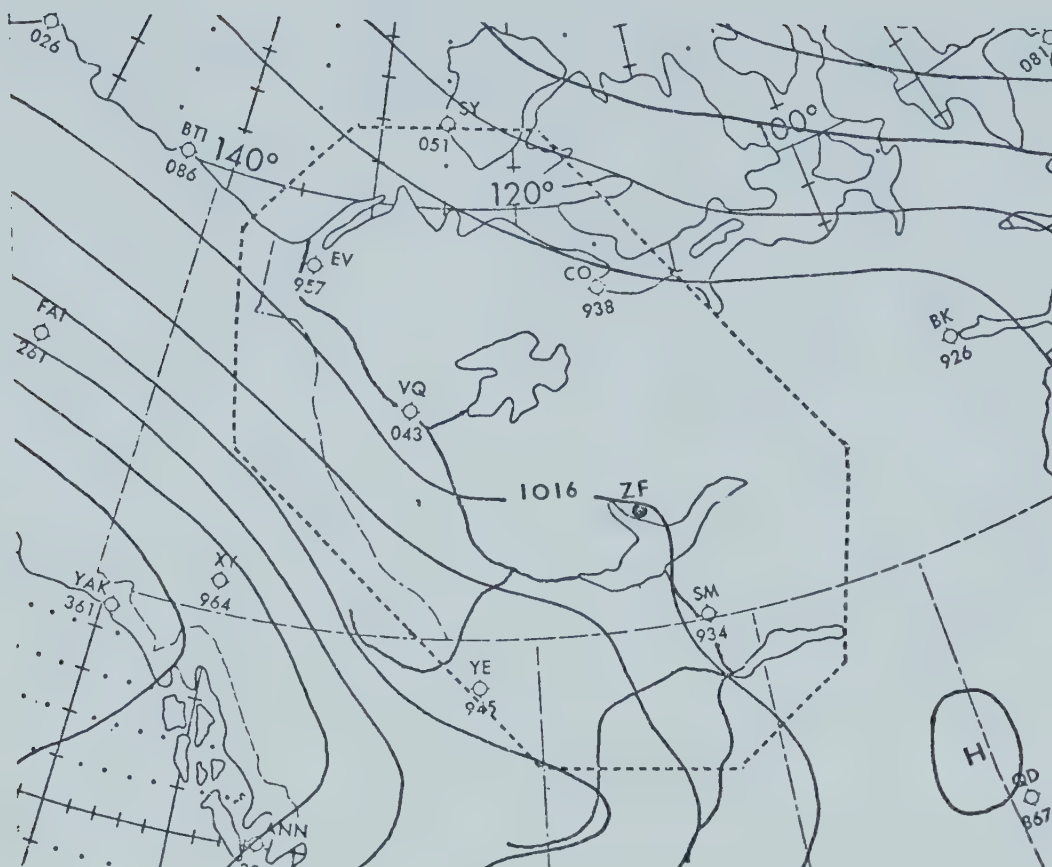
SURFACE MAP TYPE 8



KEY DATE - 12Z, 21 DEC 63

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	99/ 3	43/ 3	32/ 2	28/ 2
MEAN CORRELATION	0.883	0.899	0.881	0.859
MEAN PRESSURE (MSL)	24.05	22.05	25.69	25.23
MEAN PRESSURE GRADIENT	4.81	4.95	4.88	4.52
MEAN MAXIMUM GRADIENT	8.17	8.20	8.52	7.71
MEAN MINIMUM GRADIENT	1.71	1.75	1.80	1.55
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	5/ 31 8/ 23 2/ 23 U/ 14 11/ 6	5/ 31 8/ 28 2/ 17 U/ 14 11/ 10	2/ 35 8/ 29 5/ 24 12/ 6 U/ 6	5/ 39 2/ 22 U/ 22 8/ 11 11/ 6
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 80 2/ 14 3/ 4 5/ 2	1/ 81 2/ 10 3/ 5 5/ 5	1/ 67 2/ 25 3/ 8	1/ 88 2/ 13

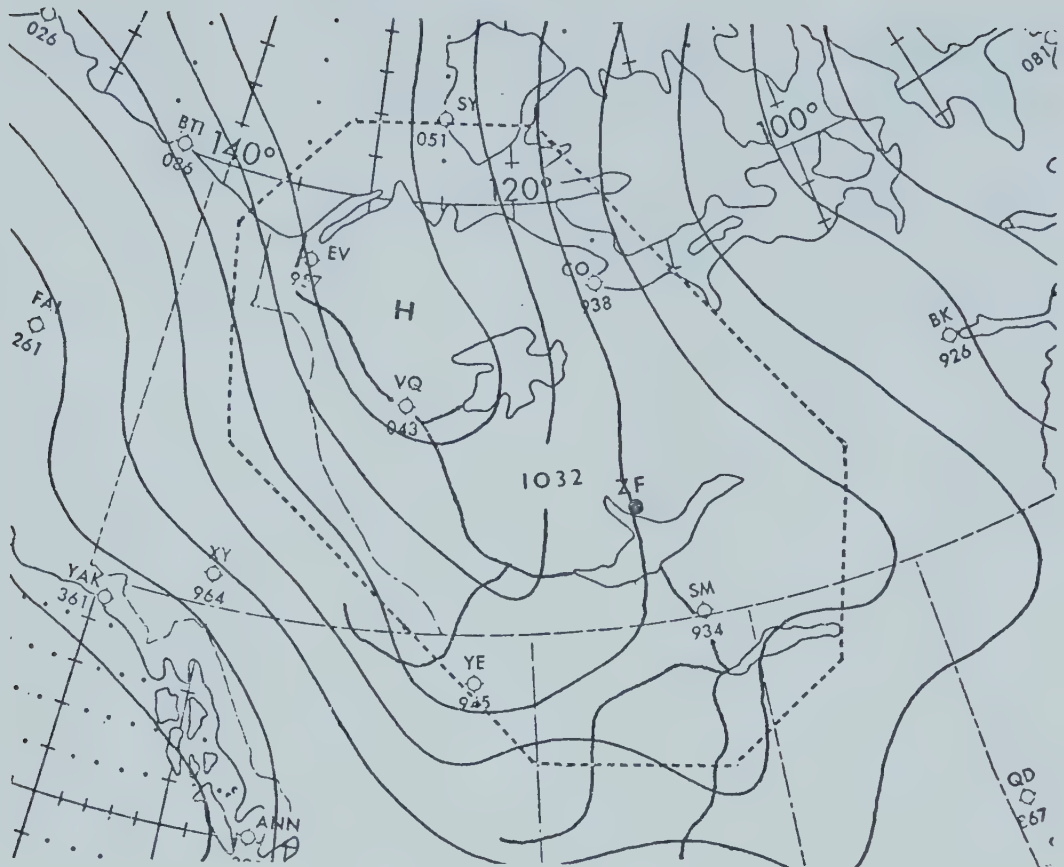
SURFACE MAP TYPE 9



KEY DATE - 12Z, 19 DEC 56

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	86/ 2	24/ 2	26/ 2	39/ 3
MEAN CORRELATION	0.859	0.853	0.857	0.864
MEAN PRESSURE (MSL)	19.28	18.22	17.98	20.78
MEAN PRESSURE GRADIENT	4.40	4.36	4.15	4.59
MEAN MAXIMUM GRADIENT	7.59	7.34	7.11	8.06
MEAN MINIMUM GRADIENT	1.24	1.27	1.21	1.24
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	9/ 30 U/ 23 6/ 12 2/ 8 21/ 8	U/ 50 6/ 19 9/ 13 2/ 6 21/ 6	9/ 33 12/ 17 15/ 17 U/ 17 7/ 11	9/ 38 2/ 15 U/ 15 6/ 12 21/ 12
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 74 2/ 14 3/ 7 4/ 5	1/ 86 2/ 14	1/ 70 2/ 10 3/ 10 4/ 10	1/ 60 2/ 20 3/ 13 4/ 7

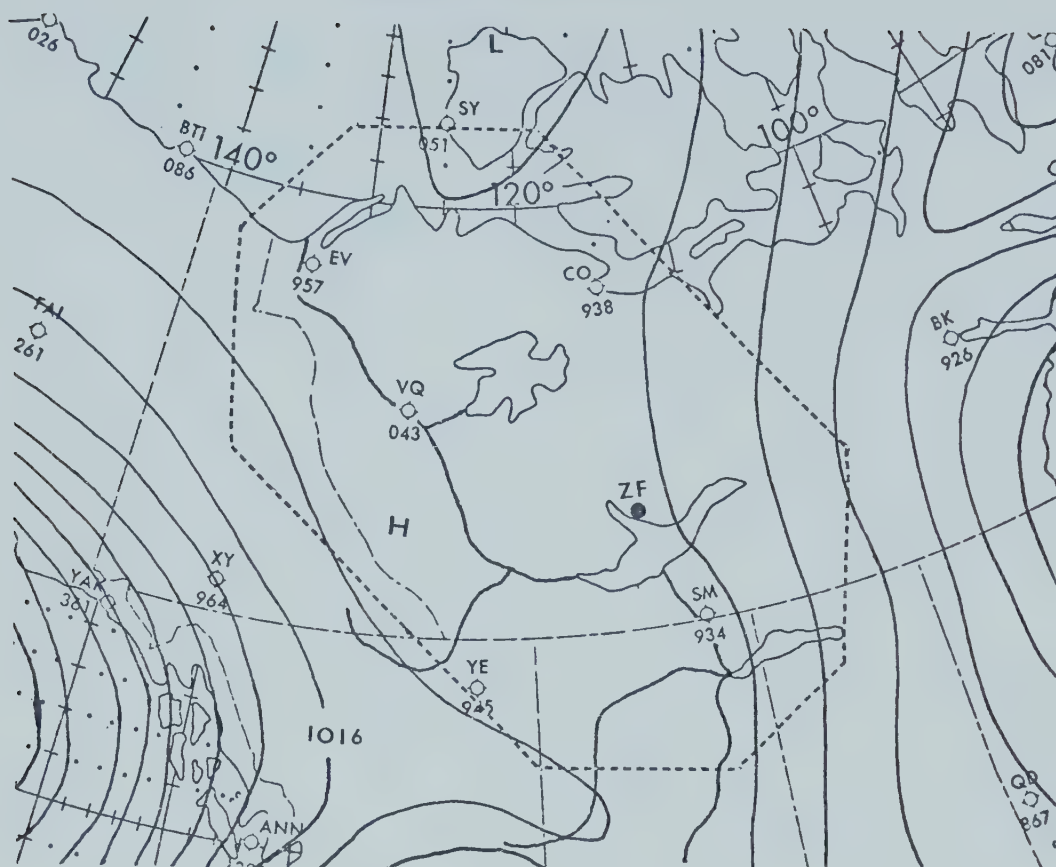
SURFACE MAP TYPE 10



KEY DATE - 12Z, 16 FEB 63

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	86/ 2	24/ 2	26/ 2	37/ 3
MEAN CORRELATION	0.869	0.863	0.869	0.874
MEAN PRESSURE (MSL)	21.47	22.24	18.00	23.41
MEAN PRESSURE GRADIENT	4.55	4.41	4.63	4.58
MEAN MAXIMUM GRADIENT	7.30	7.17	7.62	7.16
MEAN MINIMUM GRADIENT	2.06	2.09	2.14	1.99
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	U/ 31 10/ 30 3/ 8 9/ 8 1/ 6	U/ 38 10/ 19 3/ 13 9/ 13 1/ 6	U/ 40 10/ 30 1/ 5 3/ 5 7/ 5	10/ 30 U/ 26 7/ 11 1/ 7 3/ 7
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 64 2/ 31 3/ 2 4/ 2	1/ 77 2/ 23	1/ 54 2/ 46	1/ 67 2/ 28 3/ 6

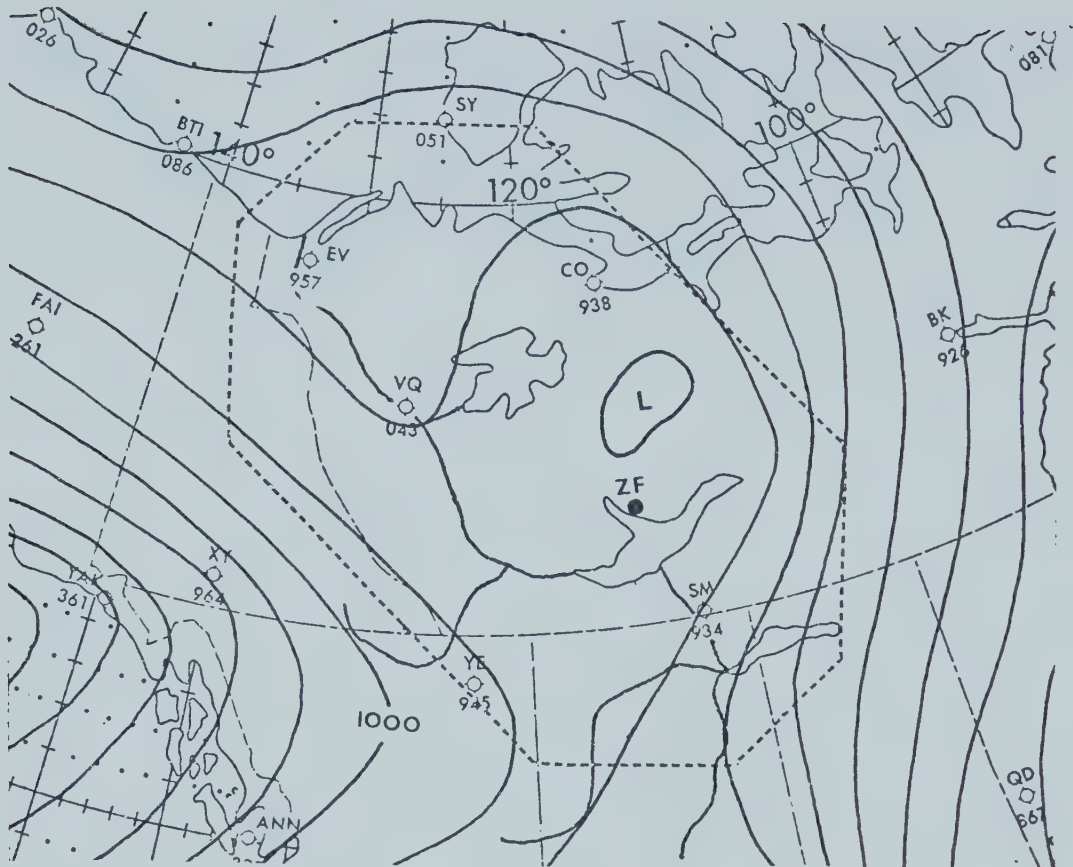
SURFACE MAP TYPE 11



KEY DATE - 12Z, 30 DEC 57

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	76/ 2	42/ 3	13/ 1	22/ 2
MEAN CORRELATION	0.874	0.870	0.883	0.875
MEAN PRESSURE (MSL)	14.16	12.90	16.70	15.07
MEAN PRESSURE GRADIENT	4.62	4.68	5.19	4.17
MEAN MAXIMUM GRADIENT	8.15	8.42	8.95	7.16
MEAN MINIMUM GRADIENT	1.78	1.85	1.76	1.66
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	U/ 38 11/ 26 5/ 8 12/ 8 2/ 5	11/ 34 U/ 29 12/ 11 2/ 9 5/ 6	U/ 44 11/ 33 21/ 11 15/ 11	U/ 53 14/ 13 5/ 13 9/ 7 11/ 7
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 80 2/ 11 3/ 4 4/ 2	1/ 78 2/ 9 3/ 4 4/ 4	1/ 67 2/ 17 3/ 17	1/ 93 2/ 7

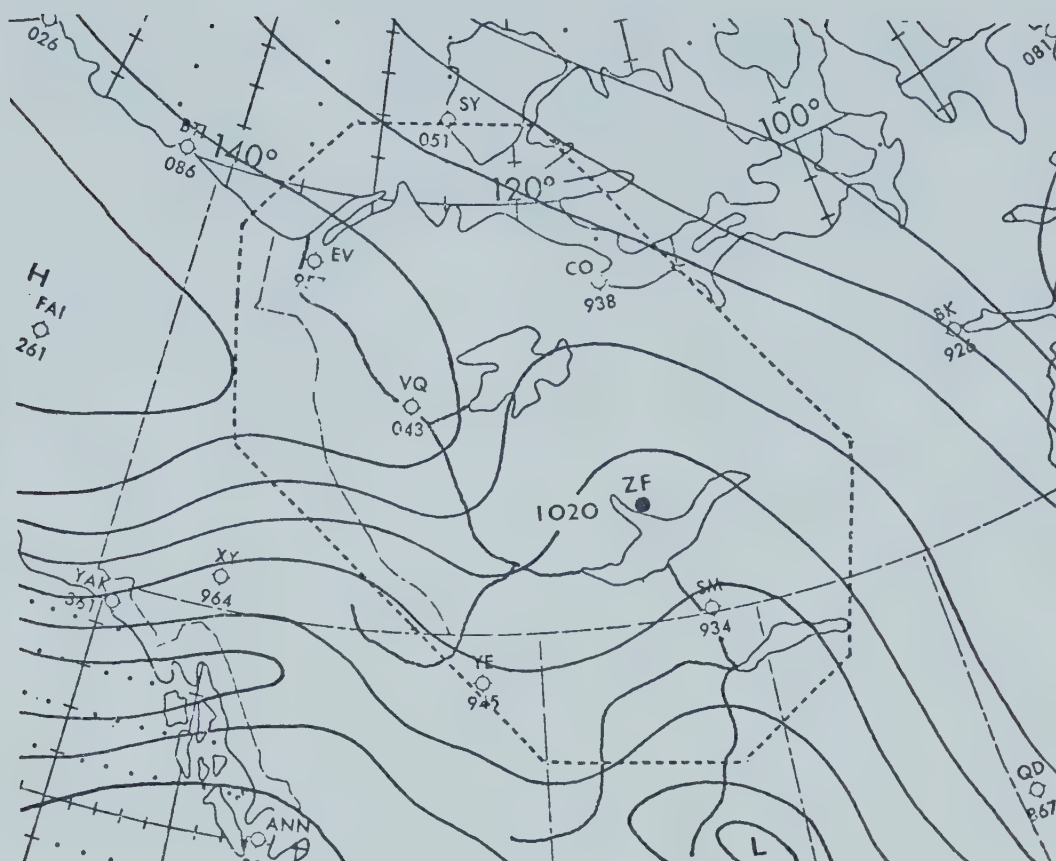
SURFACE MAP TYPE 12



KEY DATE - 12Z, 9 DEC 55

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	71/ 2	26/ 2	26/ 2	20/ 2
MEAN CORRELATION	0.866	0.883	0.859	0.854
MEAN PRESSURE (MSL)	11.71	8.92	12.27	14.62
MEAN PRESSURE GRADIENT	5.18	5.26	5.21	5.04
MEAN MAXIMUM GRADIENT	8.85	9.29	8.51	8.70
MEAN MINIMUM GRADIENT	2.41	2.26	2.50	2.48
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	U/ 43 12/ 22 6/ 15 7/ 9 2/ 4	U/ 45 6/ 20 12/ 20 1/ 5 7/ 5	U/ 48 6/ 19 12/ 19 7/ 10 9/ 5	U/ 38 12/ 23 7/ 15 2/ 8 11/ 8
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 76 2/ 19 3/ 5	1/ 77 2/ 15 3/ 8	1/ 81 2/ 13 3/ 6	1/ 70 2/ 30

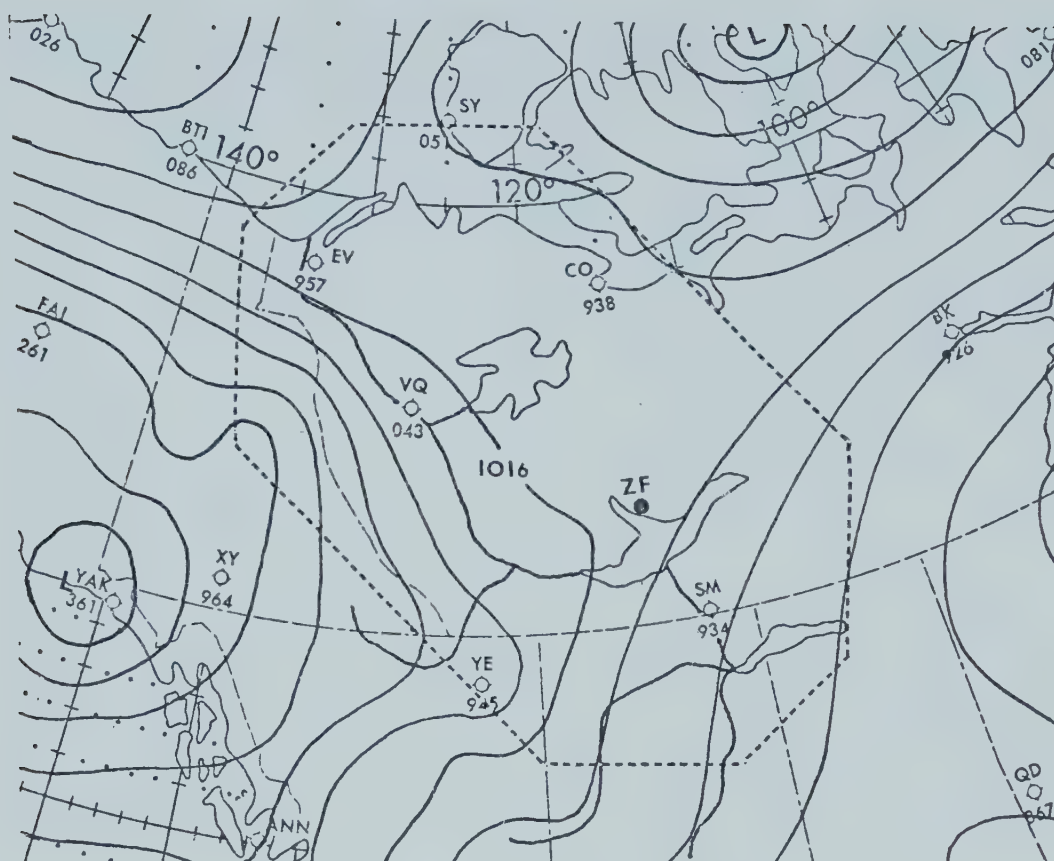
SURFACE MAP TYPE 13



KEY DATE - 12Z, 10 FEB 56

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	70/ 2	21/ 2	24/ 2	25/ 2
MEAN CORRELATION	0.862	0.877	0.856	0.854
MEAN PRESSURE (MSL)	21.09	21.91	20.62	20.84
MEAN PRESSURE GRADIENT	4.70	4.58	4.63	4.86
MEAN MAXIMUM GRADIENT	7.52	7.41	6.99	8.11
MEAN MINIMUM GRADIENT	2.06	1.99	2.17	2.01
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	U/ 38 13/ 27 1/ 22 16/ 11 19/ 2	13/ -36 U/ 29 1/ 21 16/ 14 16/ 6	U/ 47 13/ 24 1/ 18 19/ 6 16/ 6	U/ 36 1/ 29 13/ 21 16/ 14
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 70 2/ 24 3/ 6	1/ 67 3/ 22 2/ 11	1/ 67 2/ 33	1/ 73 2/ 27

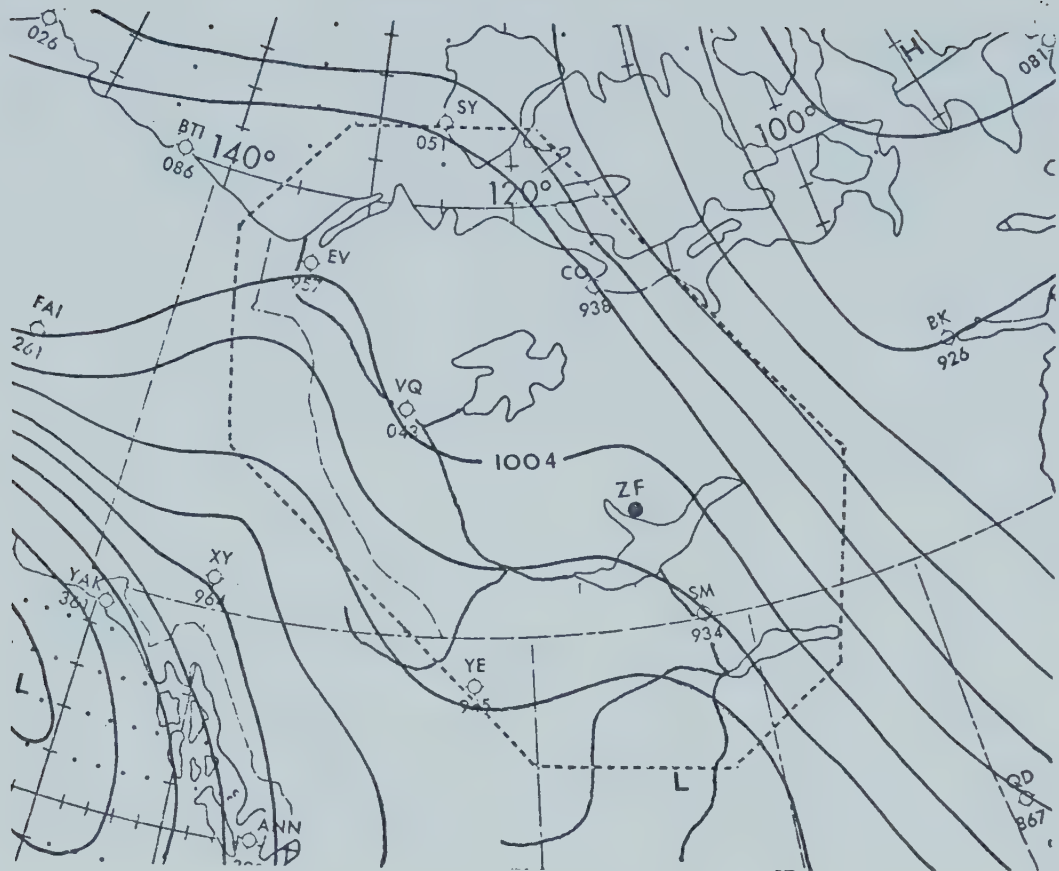
SURFACE MAP TYPE 14



KEY DATE - 12Z, 27 DEC 59

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	64/ 2	20/ 2	12/ 1	32/ 3
MEAN CORRELATION	0.867	0.860	0.870	0.870
MEAN PRESSURE (MSL)	14.43	12.58	16.38	14.85
MEAN PRESSURE GRADIENT	4.31	4.66	4.06	4.17
MEAN MAXIMUM GRADIENT	7.45	8.71	7.15	6.78
MEAN MINIMUM GRADIENT	1.54	1.67	1.05	1.65
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	U/ 40 14/ 21 12/ 15 7/ 6 11/ 6	U/ 46 14/ 31 2/ 8 5/ 8 12/ 8	12/ 38 U/ 38 7/ 13 14/ 13	U/ 38 14/ 19 11/ 12 7/ 8 12/ 8
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 79 2/ 18 3/ 3	1/ 56 2/ 44	1/ 86 2/ 14	1/ 85 2/ 10 3/ 5

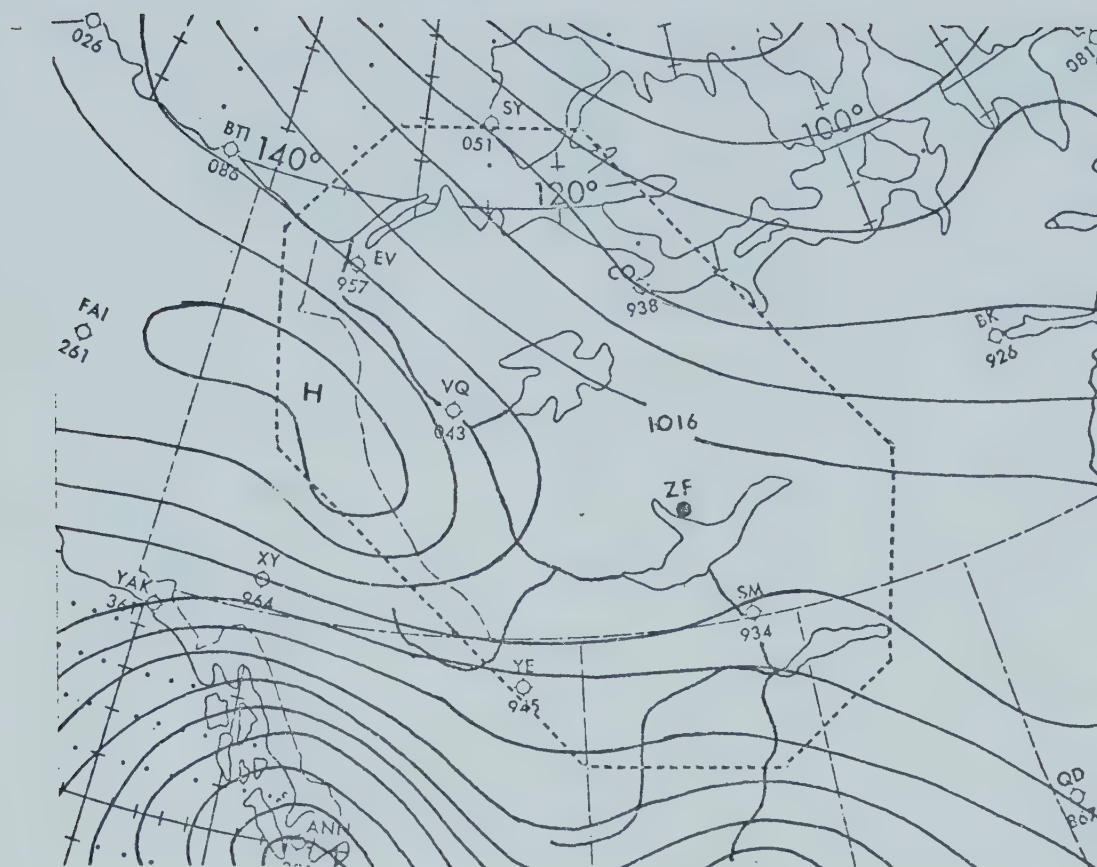
SURFACE MAP TYPE 15



KEY DATE - 12Z, 4 DEC 67

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	64/ 2	27/ 2	18/ 1	19/ 2
MEAN CORRELATION	0.857	0.865	0.847	0.855
MEAN PRESSURE (MSL)	15.81	12.13	20.03	17.06
MEAN PRESSURE GRADIENT	5.00	4.74	5.12	5.26
MEAN MAXIMUM GRADIENT	8.63	7.65	10.67	8.10
MEAN MINIMUM GRADIENT	2.29	2.27	2.19	2.42
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	15/ 32 U/ 24 6/ 18 2/ 14 7/ 2	15/ 50 U/ 18 6/ 9 2/ 9 9/ 5	U/ 38 6/ 31 15/ 19 2/ 6 13/ 6	2/ 36 15/ 18 U/ 18 6/ 9 7/ 9
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 68 2/ 26 3/ 3 6/ 3	1/ 40 2/ 40 3/ 10 6/ 10	1/ 75 2/ 25	1/ 78 2/ 22

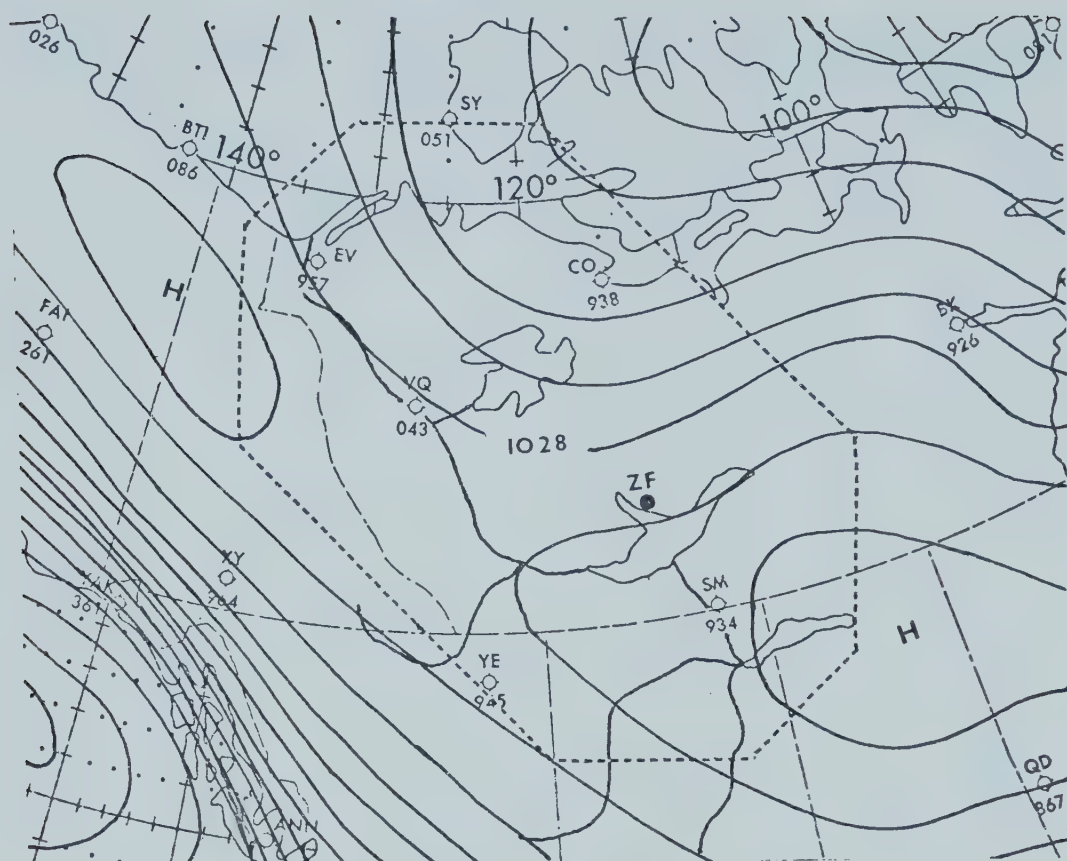
SURFACE MAP TYPE 16



KEY DATE - 12Z, 5 DEC 66

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	61/ 2	26/ 2	26/ 2	12/ 1
MEAN CORRELATION	0.864	0.870	0.860	0.860
MEAN PRESSURE (MSL)	21.72	21.02	22.76	20.97
MEAN PRESSURE GRADIENT	5.15	5.30	5.41	4.27
MEAN MAXIMUM GRADIENT	8.36	8.12	8.74	8.03
MEAN MINIMUM GRADIENT	2.01	2.32	2.13	1.06
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	16/ 35 U/ 29 4/ 15 3/ 6 17/ 4	16/ 39 4/ 30 U/ 17 22/ 9 6/ 4	16/ 35 U/ 25 3/ 15 17/ 10 4/ 5	U/ 56 16/ 33 13/ 11
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 67 2/ 23 3/ 7 4/ 3	1/ 67 2/ 17 3/ 17	1/ 50 2/ 42 3/ 8	1/ 83 4/ 17

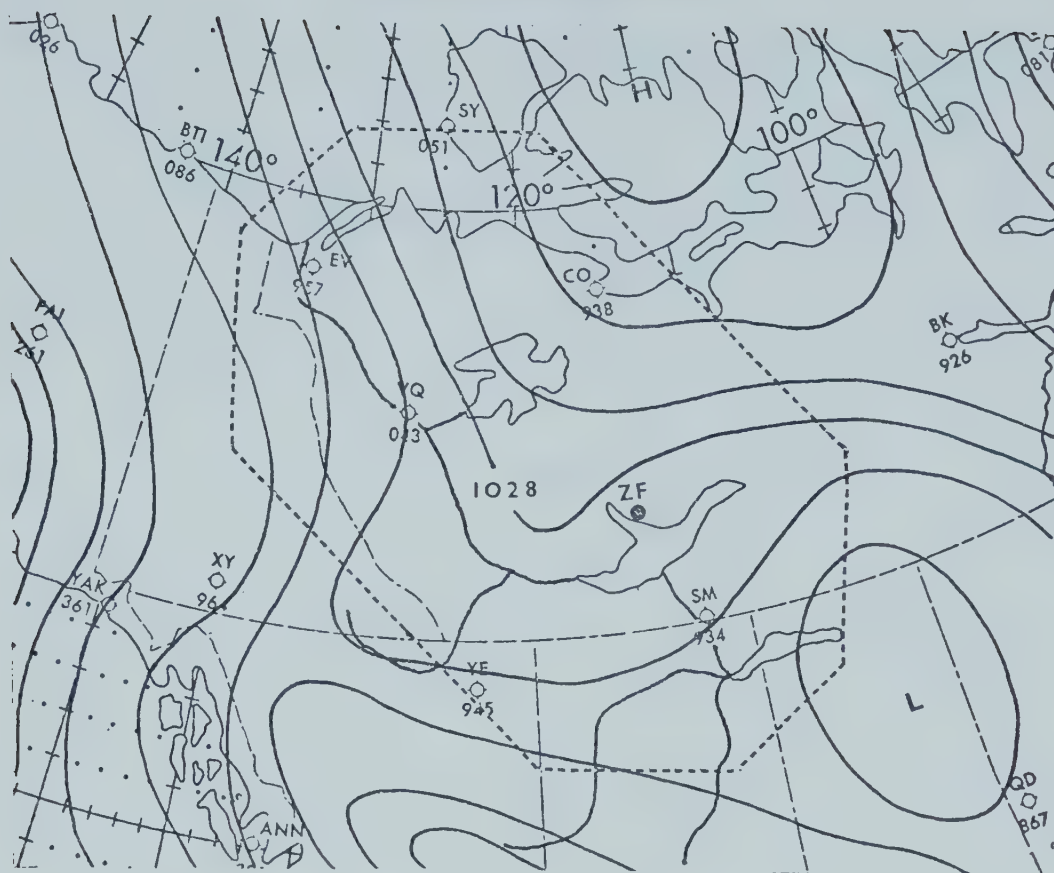
SURFACE MAP TYPE 17



KEY DATE - 12Z, 19 DEC 61

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	55/ 1	14/ 1	23/ 2	18/ 2
MEAN CORRELATION	0.863	0.877	0.867	0.848
MEAN PRESSURE (MSL)	21.68	18.74	23.19	22.05
MEAN PRESSURE GRADIENT	4.55	4.23	4.84	4.44
MEAN MAXIMUM GRADIENT	7.74	7.04	8.03	7.91
MEAN MINIMUM GRADIENT	1.59	1.50	1.79	1.40
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	U/ 50 17/ 18 3/ 8 5/ 8 4/ 5	U/ 56 7/ 11 17/ 11 5/ 11 21/ 11	U/ 37 17/ 21 3/ 11 5/ 11 16/ 11	U/ 64 17/ 18 4/ 9 3/ 9
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 84 2/ 10 3/ 6	1/ 83 2/ 17	1/ 79 2/ 14 3/ 7	1/ 89 3/ 11

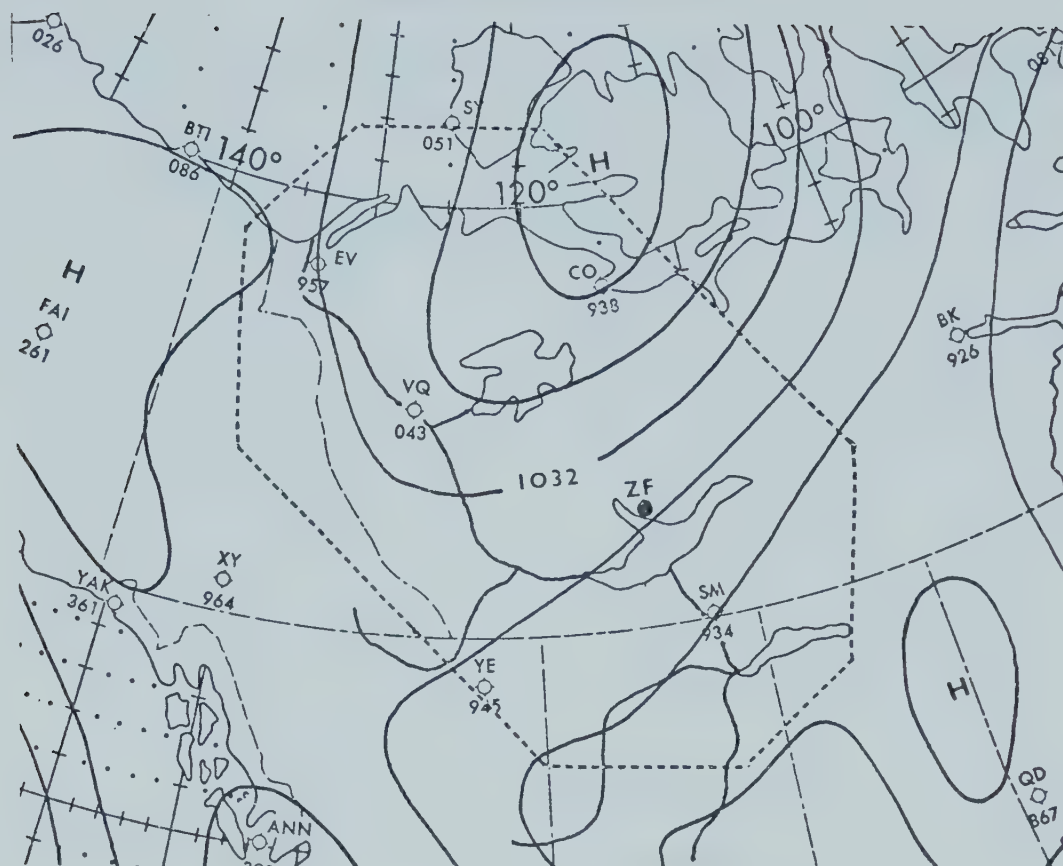
SURFACE MAP TYPE 18



KEY DATE - 12Z, 7 FEB 68

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	50/ 1	19/ 1	13/ 1	21/ 2
MEAN CORRELATION	0.853	0.848	0.862	0.851
MEAN PRESSURE (MSL)	16.54	12.08	18.50	19.36
MEAN PRESSURE GRADIENT	4.39	4.47	4.24	4.40
MEAN MAXIMUM GRADIENT -	7.47	7.53	7.14	7.61
MEAN MINIMUM GRADIENT	1.93	1.94	1.82	2.00
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	2/ 52 U/ 22 8/ 9 6/ 9 18/ 9	2/ 50 U/ 38 6/ 13	2/ 33 18/ 33 U/ 33	2/ 60 8/ 20 6/ 10 7/ 10
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 90 2/ 10	1/100	1/ 50 2/ 50	1/100

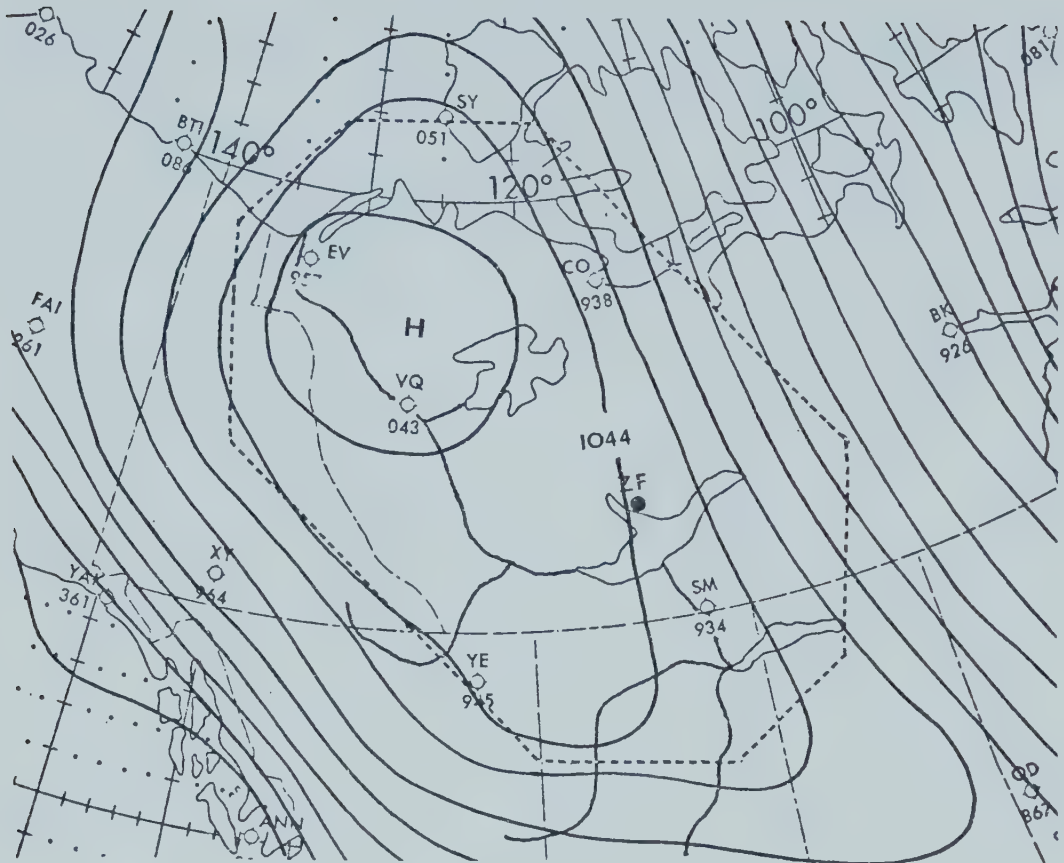
SURFACE MAP TYPE 19



KEY DATE - 12Z, 16 FEB 60

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	46/ 1	16/ 1	18/ 1	13/ 1
MEAN CORRELATION	0.851	0.857	0.839	0.861
MEAN PRESSURE (MSL)	19.71	12.12	22.82	24.74
MEAN PRESSURE GRADIENT	4.64	4.36	5.17	4.25
MEAN MAXIMUM GRADIENT	8.51	7.94	10.35	6.67
MEAN MINIMUM GRADIENT	1.96	2.23	1.80	1.85
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	U/ 32 19/ 26 6/ 10 2/ 10 18/ 10	18/ 27 19/ 18 U/ 18 1/ 9 6/ 9	19/ 33 U/ 25 6/ 17 2/ 8 23/ 8	U/ 57 19/ 29 2/ 14
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 70 2/ 26 3/ 4	1/ 78 2/ 22	1/ 63 2/ 25 3/ 13	1/ 60 2/ 40

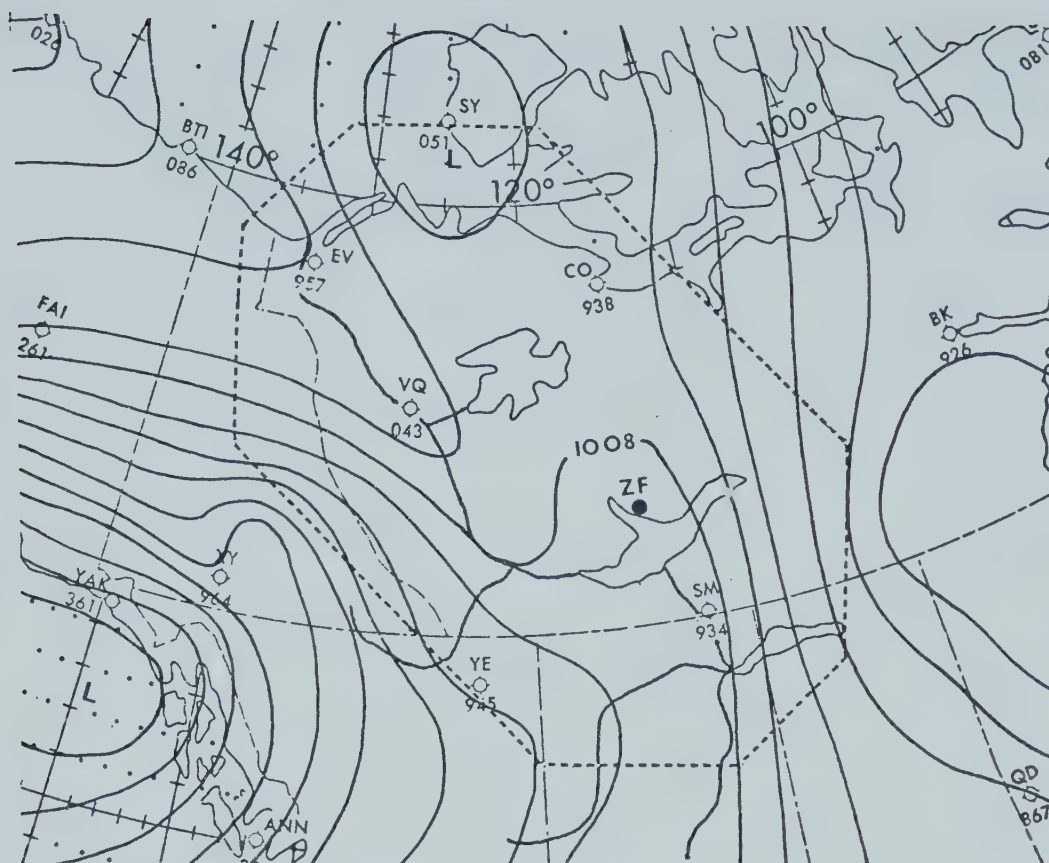
SURFACE MAP TYPE 20



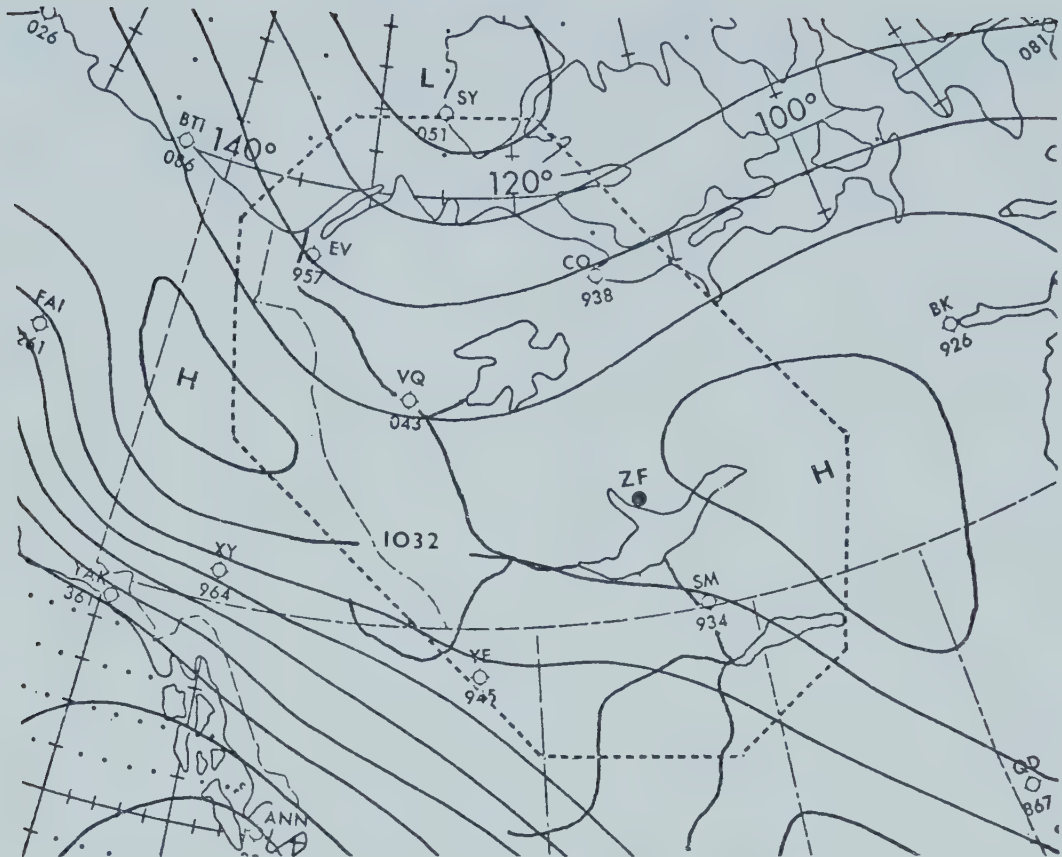
KEY DATE - 12Z, 19 DEC 60

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	34/ 1	11/ 1	11/ 1	12/ 1
MEAN CORRELATION	0.859	0.865	0.851	0.862
MEAN PRESSURE (MSL)	26.57	22.34	28.48	28.70
MEAN PRESSURE GRADIENT	4.35	4.03	4.82	4.20
MEAN MAXIMUM GRADIENT	7.42	6.66	8.57	7.07
MEAN MINIMUM GRADIENT	1.60	1.63	1.58	1.59
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	U/ 43 20/ 19 8/ 10 2/ 10 1/ 5	20/ 40 U/ 40 8/ 20	U/ 33 20/ 22 7/ 11 2/ 11 13/ 11	U/ 57 8/ 14 2/ 14 24/ 14
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 82 2/ 12 3/ 6	2/ 67 1/ 33	1/ 83 3/ 17	1/100

SURFACE MAP TYPE 21



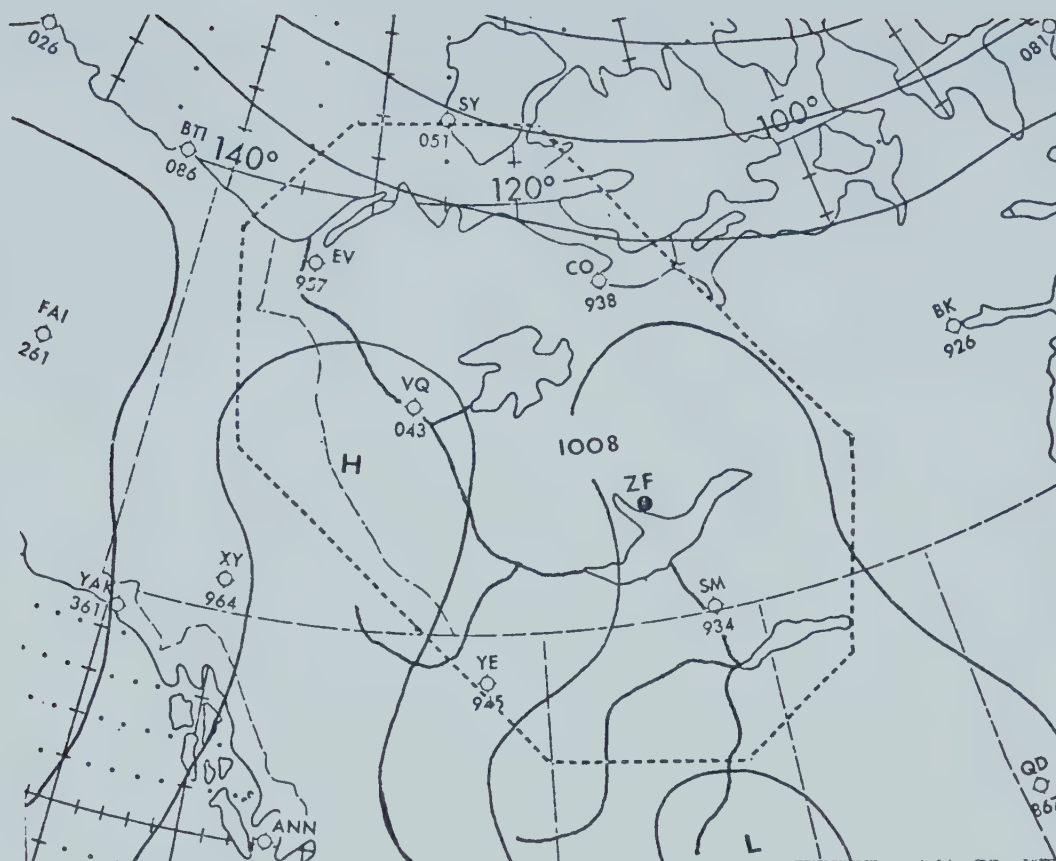
SURFACE MAP TYPE 22



KEY DATE - 12Z, 3 DEC 70

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	21/ 1	13/ 1	6/ 0	3/ 0
MEAN CORRELATION	0.847	0.858	0.822	0.851
MEAN PRESSURE (MSL)	21.40	19.15	27.55	18.85
MEAN PRESSURE GRADIENT	4.40	4.82	3.87	3.68
MEAN MAXIMUM GRADIENT	8.23	9.16	7.04	6.59
MEAN MINIMUM GRADIENT	1.52	1.58	1.57	1.17
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	U/ 40 4/ 27 22/ 20 13/ 13	U/ 33 22/ 25 4/ 17 13/ 17 16/ 8	U/100	4/100
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 75 2/ 25	1/ 67 2/ 33	1/100	1/100

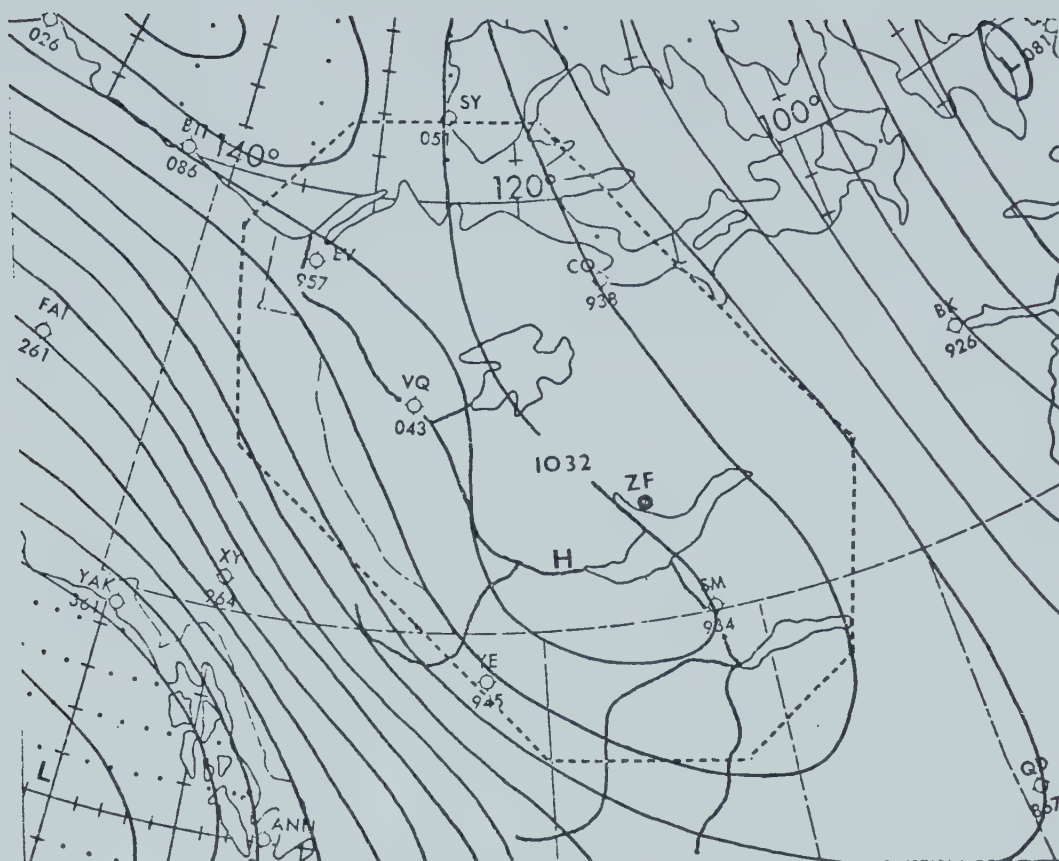
SURFACE MAP TYPE 23



KEY DATE - 12Z, 13 JAN 55

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	17/ 0	7/ 1	8/ 1	2/ 0
MEAN CORRELATION	0.862	0.870	0.861	0.839
MEAN PRESSURE (MSL)	28.40	32.79	27.36	17.20
MEAN PRESSURE GRADIENT	4.04	4.29	3.80	4.13
MEAN MAXIMUM GRADIENT	6.45	6.39	6.22	7.60
MEAN MINIMUM GRADIENT	1.21	1.45	1.11	0.75
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	U/ 60 23/ 27 1/ 7 19/ 7	23/ 57 U/ 43	U/ 67 1/ 17 19/ 17	U/100
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 82 2/ 9 4/ 9	1/ 33 2/ 33 4/ 33	1/100	1/100

SURFACE MAP TYPE 24



KEY DATE - 12Z, 19 FEB 68

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	11/ 0	2/ 0	1/ 0	8/ 1
MEAN CORRELATION	0.853	0.858	0.819	0.856
MEAN PRESSURE (MSL)	26.05	24.65	26.95	26.29
MEAN PRESSURE GRADIENT	4.30	3.55	3.88	4.54
MEAN MAXIMUM GRADIENT	8.38	7.10	6.02	8.99
MEAN MINIMUM GRADIENT	1.72	2.25	2.06	1.55
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	U/ 45 7/ 18 2/ 18 9/ 9 24/ 9	7/ 50 2/ 50	9/100	U/ 63 7/ 13 2/ 13 24/ 13
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 90 2/ 10	1/100	1/100	1/ 86 2/ 14

SURFACE MAP TYPE U

PERIOD	SEASON	DEC	JAN	FEB
OCCURRENCES/FREQUENCY	1263/ 34	471/ 36	415/ 32	414/ 35
MEAN CORRELATION	0.702	0.697	0.702	0.706
MEAN PRESSURE (MSL)	19.65	17.17	22.01	20.12
MEAN PRESSURE GRADIENT	4.04	4.14	4.10	3.88
MEAN MAXIMUM GRADIENT	7.03	7.25	7.07	6.74
MEAN MINIMUM GRADIENT	1.57	1.63	1.58	1.48
MOST FREQUENTLY FOLLOWING MAP TYPE (MAP TYPE/FREQUENCY)	U/ 52 1/ 6 4/ 4 8/ 4 7/ 4	U/ 54 1/ 7 4/ 6 8/ 4 5/ 4	U/ 50 4/ 7 1/ 7 2/ 5 8/ 4	U/ 51 2/ 6 1/ 5 7/ 5 14/ 5
MOST FREQUENT DURATION (NUMBER OF 12-HOUR PERIODS/FREQUENCY)	1/ 49 2/ 25 3/ 14 4/ 5	1/ 46 2/ 28 3/ 16 4/ 5	1/ 56 2/ 21 3/ 13 4/ 4	1/ 50 2/ 26 3/ 9 4/ 7

APPENDIX 4

THE BRIER P-SCORE

The simple forecast model used in this study is based on the conditional probabilities of ceiling and visibility categories. Root (1962) stresses the importance of resolution and reliability when evaluating weather forecasts that contain numerical probability statements. Forecasts with good resolution have forecast probabilities near zero percent or 100 percent. Those with poor resolution have probabilities near the climatological frequency. Forecasts with good reliability have event forecast probabilities which correspond closely with the relative frequency of the respective events.

In this study, weather events are related to synoptic situations. Hence, successive hourly forecasts for a given situation are not likely to be independent. Thus, where the number of forecasts in a given category is small, a single synoptic situation may account for a large percentage of the cases. This introduces a bias in the observed frequency of occurrence. A stable observed frequency of event occurrence is required to maintain good forecast reliability; this can best be accomplished by having a large number of occurrences. Reliability is important in this study because increased data stratification results in fewer cases available for calculating forecast conditional probabilities. Hopefully, any loss of reliability due to increased stratification can be more than compensated for by better

resolution.

A good verification score to use in this study is the Brier P-Score (Brier, 1950) because it measures both the resolution and reliability of probability forecasts. The score is calculated from the formula

$$P = \frac{1}{N} \sum_{j=1}^r \sum_{i=1}^N (f_{ij} - E_{ij})^2, \quad (A4-1)$$

where on each of N occasions an event can occur in one of r possible categories, and f_{ij} represents the probability that the forecast was for a category j occurrence. In this study the r categories for each forecast parameter are mutually exclusive and exhaustive, i.e.,

$$\sum f_{ij} = 1$$

E_{ij} takes the value of one or zero, depending on whether or not the event occurred, respectively, in category j . The best score for perfect forecasting is a value of zero and the worst value possible is two. This score represents essentially the mean of the squares of the difference between the forecast and observed probability distributions. It is desirable to have a minimum difference; therefore, a good score has a small value.

To isolate the reliability factor in the P-Score formula, it is best to consider each individual category forecast separately, rather than referring to a set of category forecasts. The Brier Score for N forecasts now reduces to

$$B = \frac{1}{N} \sum_{i=1}^N (f_i - E_i)^2, \quad (A4-2)$$

and the maximum possible value is one, rather than two.

The forecast reliability is determined by comparing the forecast probabilities against the observed percent occurrences of an event. To facilitate such a comparison, the forecast probabilities can be subdivided into intervals of 10 percent width, so that all probabilities f_i , are expressed in tenths. This results in 11 classes

$$f_i = 0.0, 0.1, 0.2, \dots, f_k, \dots, 1.0,$$

where f_1 contains probabilities from 0.0 to 0.04; f_2 from 0.05 to 0.14 ... etc.

Consider a class "k" which consists of M_k probability forecasts of a category, and a total of R_k event occurrences. The ratio of event occurrences to probability forecasts for the k^{th} class is

$$\phi_k = \frac{R_k}{M_k} \quad (\text{A4-3})$$

For example, if the ceiling category A occurred seven times, and was forecast at a probability of 80 percent to occur ten times, then

$$\phi_9 = \frac{7}{10} = 0.7.$$

From (A4-2), the contribution to the Brier Score for the event occurrences is $1/M_k (f_k - 1)^2 R_k$, and the contribution for non-occurrences is $1/M_k (f_k - 0)^2 (M_k - R_k)$. The Brier Score for the k^{th} class becomes

$$B_k = (f_k - 1)^2 \phi_k + f_k^2 (1 - \phi_k). \quad (\text{A4-4})$$

By adding and subtracting ϕ_k^2 and rearranging terms, (A4-4) can be

written as

$$B_k = (f_k - \phi_k)^2 + \phi_k (1 - \phi_k). \quad (A4-5)$$

The score for the whole set of N forecasts of a category is the weighted average of the scores obtained in the 11 classes

$$B = \frac{1}{N} \sum_{k=1}^{11} M_k B_k = \frac{1}{N} \sum_{k=1}^{11} M_k \{ (f_k - \phi_k)^2 + \phi_k (1 - \phi_k) \}. \quad (A4-6)$$

In this form the Brier-score formula is separated into its reliability and resolution components.

The reliability term, $(f_k - \phi_k)^2$, measures the difference between the forecast probability f_k and the relative frequency of occurrence of the event, ϕ_k . A root-mean-square error (RMSE) in reliability can be defined from (A4-6) as

$$RMSE = \frac{100}{N} \sum_{k=1}^{11} M_k (f_k - \phi_k)^2, \quad (A4-7)$$

with the values expressed as percentages.

The second term in (A4-6) expresses the resolution of the forecasts and depends only on the value of ϕ_k . It has a minimum value when ϕ_k is either one or zero. This happens when the event always occurs when forecast at 100 percent probability, or when the event never occurs when forecast at zero percent. When $\phi_k = 0.5$, the resolution term has its maximum value of 0.25.

In this study Brier Scores are used to verify probability forecasts based on pure seasonal climatic frequencies, as well as those based on climatic frequencies that have been stratified by map type and pressure gradient. To compare results, a simple skill score

is used that gives the percentage improvement of stratified-climatology forecasts over pure climatology forecasts. It is calculated from the formula

$$S = 100 (1 - sB/cB),$$

where sB is the Brier Score for stratified forecasts and cB is the score for climatology forecasts.

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